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Strategic Futures

Evolving Missions for Traditional Strategic Delivery Vehicles

Richard Mesic, Roger Molander, Peter A. Wilson

Prepared for the Defense Advisory Group to the National Defense Research Institute

National Defense Research Institute

RAND

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PREFACE

This report summarizes work by RAND and its subcontractor, Defense Group, Inc., for the Strategic and Space Systems office of the Undersecretary of Defense for Acquisition and Technology (USD[A&T]/S&SS). The objective was to garner a long-term view of potential future national security applications for what have traditionally been labeled U.S. "strategic forces"—intercontinental ballistic missiles, submarine-launched ballistic missiles, and long-range bombers. The study was undertaken in recognition that the United States is in the midst of a profound change in the strategic environment. It was an effort to identify initiatives for research, development, and acquisition of strategic forces that would be tailored to the potential needs of that still-evolving environment.

The report should be of interest to analysts, technologists, planners, policymakers, and strategists concerned with military problems in the new strategic environment, particularly those interested in the potential contribution of advanced technology for U.S. long-range strategic nuclear forces that may have emerging counterproliferation missions as well as traditional ones. It should also be of interest to individuals within the Congress, academia, and the media who are looking at the challenge of developing a national (and potentially global) political consensus on strategies and policies to support nonproliferation and counterproliferation.

The work reported here was accomplished within RAND's Acquisition and Technology Policy Center; the project was sponsored by the Defense Advisory Group of the National Defense Research

Institute, a federally funded research and development center (FFRDC) sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies.

CONTENTS

FIGURES

TABLES

SUMMARY

This report addresses the post–Cold War role of traditional U.S. strategic nuclear forces (nuclear-armed long-range bombers, intercontinental ballistic missiles [ICBMs], and submarine-launched ballistic missiles [SLBMs]) from three perspectives:

1. "Top-down"/goal-driven: In the new and evolving strategic environment, what strategic missions may be needed to fulfill emerging national security objectives?
2. "Bottom-up"/technology- and system-driven: What technological opportunities are afforded by existing and potential capabilities?
3. Policy issues: How will various policy choices affect research and development (R&D), acquisition, and counterproliferation strategy alternatives?

The study's objective was to gain a long view of possible directions for future strategic forces and lay out the basis for supportable R&D and acquisition initiatives to be pursued by defense agencies and the Services.

THE STRATEGIC ENVIRONMENT

The "strategic future" facing the United States is uncertain. There are promising trends in some areas, dangerous indicators in others. The Cold War is over and thousands of strategic nuclear weapons once targeted at the United States are being dismantled. At the same

time, the strategic environment has become more complicated. A new strategic threat—the proliferation of weapons of mass destruction (WMD) posing threats in regions where the United States has vital security interests as well as to the U.S. homeland—is undeniably taking form. These new strategic threats raise the prospect of new demands on traditional U.S. strategic weapons capabilities. The trend of nuclear proliferation in this context is of particular concern.

STRATEGIC MISSIONS: RESIDUAL DETERRENCE AND COUNTERPROLIFERATION

Our "top-down" analysis identified two possible missions that U.S. strategic forces may be asked to perform in the new environment: (1) some version of the traditional or "residual" deterrence mission, and (2) a new mission—counterproliferation.

Residual Deterrence

The mission of U.S. strategic forces has been to deter nuclear attack on the United States and key allies. Even in the new strategic environment that is focused on regional contingencies, it is likely that the United States will need to maintain a deterrent of this kind because some of our potential regional adversaries have or will have nuclear weapons. This means that at some point there will almost certainly be a next generation of U.S. strategic nuclear forces. It is, however, unclear what this next generation of delivery systems and nuclear weapons should look like or how large the force should be. As we consider the design of a new force of strategic delivery vehicles, we will have the first opportunity since the Cold War to shape force modernization in a way that could enhance strategic security at a lower overall investment level.

In the short run, however, we may want to move toward more rapid dealerting and disengaging of U.S. and former Soviet strategic nuclear forces than START II demands (see the Appendix). Indeed this is already happening. Consider the disengagement measures already taken: dealerting and detargeting of some ICBMs, removing nuclear weapons from bombers, taking bombers off day-to-day strip alert, and ending the continuous airborne alert of Looking Glass. Such moves by the United States and Russia, backing away from the edge

of the nuclear abyss that largely defined the Cold War, seem to foreshadow new and different deterrence strategies, force postures, and systems. It now seems that nuclear weapons will be cast strategically as a force of last resort rather than as a flagship symbol of national power and influence.

Events have clearly overtaken earlier plans and programs for traditional strategic nuclear forces. To date, our response to this situation has been to change our nuclear posture substantially in quantitative terms but little in qualitative terms—a response that has been reinforced by the results of the Department of Defense's Nuclear Posture Review (NPR).

Counterproliferation

The spread of weapons of mass destruction—especially nuclear weapons—represents a profound threat to the U.S. post–Cold War regional security strategy and force posture. In time—perhaps soon if unconventional means of delivery are exploited—it will also present a profound threat to the U.S. homeland.

The term that has been chosen for the broad range of possible U.S. military responses to this overall threat—with the twin objectives of supplementing and enhancing traditional nonproliferation efforts—is *counterproliferation*. Counterproliferation is the principal arena in which traditional strategic forces may be expected to perform new and challenging missions.

There is currently no broad strategy or policy framework that incorporates the prospect of facing WMD-armed adversaries in, for example, multipolar regional strategic contingencies. Much less is there any consensus between the United States and its allies on doctrine or policy for responding to nuclear or other WMD threats. As a consequence, many facets of the counterproliferation problem, including issues both common and unique to various regional contingencies, are not yet well defined. On the other hand, certain of these problems are already defined well enough (for example, Scud hunting and the North Korean "deep underground tunnels") to foster consensus on the urgent need to seek solutions to these problems.

TECHNOLOGICAL OPPORTUNITIES

The "bottom-up" analysis of our study focused on technological opportunities vectored toward an emphasis on various key counterproliferation tasks and missions. In particular, the study examined the prospect of using long-range strategic delivery platforms equipped with technologically sophisticated new weapons (both nuclear and nonnuclear) coupled to advanced sensors to attack the WMD forces of an adversary, identifying key engineering tasks in support of possible deterrent and/or counterforce objectives in potential future regional crises.

Regrettably, the candidate strategic system solutions we identified and examined provided at best—at this stage—an imperfect capability. The dominant problem in making long-range and short-time-of-flight weapons systems strategically effective is unquestionably tactical intelligence on target location—the timely delivery of operationally actionable intelligence on the location of WMD delivery vehicles, launchers, and warheads to the "shooters." For example, missiles hidden in underground caves or tunnels with hidden exits pose a daunting problem for tactical intelligence.

Nonetheless, some concepts for using long-range delivery platforms can be helpful in certain scenarios and contingencies, but it must be kept in mind that this is a very new area of investigation and analysis. Moreover, certain counterproliferation capabilities (such as catching dispersing missiles in garrison or destroying frequently moved nuclear weapons with conventional weapons once a location is determined) might be achieved only via the fast flight times and firepower potential of ICBMs and SLBMs.

Figure S.1 depicts an exemplary set of concepts for such applications:

High-Altitude Long-Endurance (HALE) Surveillance Systems. This concept envisions the deployment of long-endurance vehicles with passive and active sensors to achieve continuous surveillance of WMD garrisons and dispersal areas for warning, targeting, and bomb damage assessment (BDA) at minimum risk to U.S. forces. Intelligence identifies garrisons and dispersal areas; U.S.-based aircraft (e.g., B-52s) ferry HALE vehicles to deployment areas.

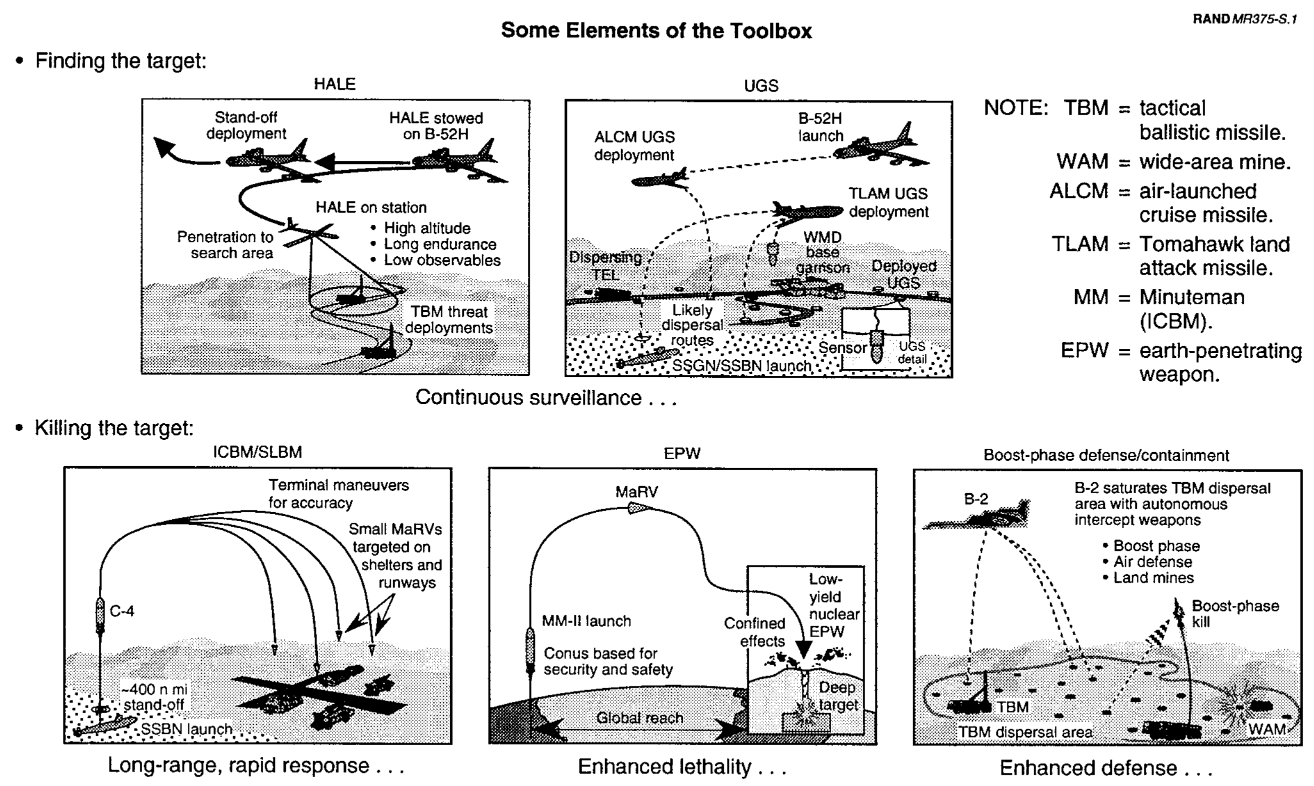


Figure S.1—Exemplary Counterproliferation Systems Concepts

Unattended Ground Sensors (UGSs). In this concept, aircraft or ballistic missiles would deploy nuclear, chemical, biological, seismic, acoustic, or visual sensors in and around garrisons and dispersal routes for detection, targeting, and bomb damage assessment of mobile missiles. UGSs report through HALE or via satellite.

Nonnuclear ICBMs/SLBMs. This concept would exploit the kill potential of ICBM/SLBM delivery of large nonnuclear payloads—for example, maneuvering reentry vehicles (MaRVs)—over large geographic regions against airfields, surface-to-air missile (SAM) sites, leadership, command control, communications, and intelligence (C3I), etc., with quick reaction, minimal warning, high probability of penetration, and no risk of loss or capture of U.S. crews.

Earth-Penetrating Weapons (EPWs). This concept would increase the lethality potential of ICBM/SLBMs through enhanced conventional/unconventional nonnuclear or small-yield nuclear weapons (e.g., less than one kiloton) to destroy or disable deeply buried (50–100 ft) underground targets with minimal risk to U.S. forces and contained collateral effects (e.g., no fallout for nuclear EPWs). Such systems may also be critical in attacking biological warfare facilities.

Autonomous Prelaunch/Boost-Phase Intercept Weapons. This concept provides time-urgent pin down of adversary strategic weapons via covert aircraft delivery of autonomous boost-phase intercept weapons, air defense weapons, or smart mines.

POLICY ISSUES

To help identify and clarify issues related to the objectives of this study—as well as to stimulate dialogue on the overall counterproliferation problem—we conducted a policy-based planning exercise (employing a Middle East scenario) derivative of other RAND work on the counterproliferation problem.[1] The exercise called for policy and operational responses to Iranian aggression in the Middle East involving the threat of both nuclear and conventional WMD. Senior officials from the Office of the Secretary of Defense, the individual

[1]See Marc Dean Millot, Roger Molander, and Peter A. Wilson, *"The Day After . . ." Study: Nuclear Proliferation in the Post–Cold War World*, RAND, Volumes I, II, and III, MR-266-AF, -253-AF, and -267-AF, respectively, 1993.

Services, Department of Defense agencies, the intelligence community, and the United States Strategic Command (USSTRATCOM) participated. The exercise provided participants with a first-order immersion in potential counterproliferation problems and stimulated strong interest and a wide spectrum of innovative thinking on the role of new technologies and new long-range delivery and weapons systems in addressing these potential problems. Although the exercise produced no consensus regarding specific technology or strategic system initiatives (or policy measures the United States should adopt to confront such a contingency), there was recognition and agreement that the United States is not yet well prepared to go forward with an integrated set of such initiatives and policy measures, and in fact lacks an overall strategy for dealing with these emerging problems. In the context of considering overall strategy and policy, it is important to acknowledge the likely future contribution of defenses—both in the theater and of the U.S. homeland—in addressing the counterproliferation problem. For example, in contemplating a preemptive attack on the WMD forces of a future regional adversary (or deterring such an adversary from adverse action), a U.S. president will need to recognize the near impossibility of achieving 100 percent kill of adversary WMD forces in an initial counterforce attack and the need to consider the potential contribution of defenses—against not just missiles but also slow-motion strategic delivery vehicles such as freighters capable of launching minisubmarines against U.S. port cities.

CONVERGENCE: A HYPOTHETICAL EXAMPLE

The project's three strands of research do, however, converge in pointing toward a set of R&D initiatives that should support the development of fundamental strategic goals, exploit existing technological opportunities, and help address political and operational problems likely to emerge in the new strategic environment.

To choose a hypothetical example: The "top-down" research highlights the need for mission capabilities to perform a number of tasks aimed at preempting WMD threats. One of these includes destroying enemy mobile missile forces. The "bottom-up" research identified relevant opportunities afforded by strategic technologies: long-range capability, which permits force application from outside a regional

theater; the short flight time for ICBMs and SLBMs, which (when supplemented by sufficient intelligence) could destroy key strategic targets such as dispersing mobile missiles and nuclear weapons that are moved frequently for survivability; surprise potential that is a by-product of the ability to strike without massive and visible force deployments; and the minimization of casualties enabled by stand-off attacks. The policy exercise confronted participants with the military option of launching a preemptive strike against Iranian nuclear WMD. Although the participants did not reach consensus on the advisability of doing this, there was more agreement that Scud hunting is not a serious option at present, since the United States does not have an adequate capability for doing so.

These points converge in suggesting research into the use of ballistic missile conventional weapons to hold at risk mobile WMD. Areas in which continuing or expanded research is clearly called for include:

- Target acquisition: low-observable covertly deployable unattended ground sensors, high-altitude long-endurance aircraft, satellite-based radars and multispectral sensors, and covert tagging for continuous surveillance after strategic warning.
- Payload development: maneuvering reentry vehicles capable of in-flight update on target location, conventional and nuclear earth-penetrating weapons, and electromagnetic pulse (EMP) weapons for attack of dispersing forces and C3I nodes.
- Mission planning: systematic assessment of time lines and coordination with regional forces for preemptive attack and immediate follow-on military action.

NEXT STEPS

This study represents a first set of steps in identifying problems and technological opportunities in the emerging strategic environment. In terms of the traditional residual nuclear deterrent, the near term holds opportunities rather than imperatives, whereas the long term holds a clear imperative for responsible stewardship over a vital U.S. strategic asset.

In contrast, the prospect of at least partial failure of nuclear nonproliferation efforts poses serious strategic challenges, not only for the

force projection component of U.S. regional strategy but for the overall strategic nuclear posture. Undeniably, the United States would benefit from a range of regional strategic capabilities—an ability to make or counter moves on a regional strategic chessboard—well beyond those offered by currently planned and programmed strategic systems and, in some cases, even beyond those capabilities currently foreseeable with projected technologies and system concepts identified in this report.

The work that lies ahead involves embedding these technologies and system concepts—including the critical intelligence components—in responsive power projection campaign architectures, strategies, doctrines, and tactics; developing and testing them; and then, from a total force perspective, formulating a military and intelligence investment strategy commensurate with the evolving global strategic environment.

ACKNOWLEDGMENTS

The authors wish to acknowledge the contribution of Eugene Gritton in the formulation and initiation of this study and the highly constructive comments on an early draft by John Schrader, David Adamson, and Russell Shaver. Gary Aubert and Richard Rauch of Defense Group, Incorporated, were responsible for many of the innovative concepts and technology assessments. Finally, Greg Hulcher of USD(A&T)/S&SS pushed hard with us to thoroughly explore the emerging strategic systems issues and opportunities and to involve the community, including members of operational commands such as Major General Robert Linhard of USSTRATCOM, in these exploratory analyses.

SYMBOLS

ACM	advanced cruise missile
AD	air defense
ALCM	air-launched cruise missile
ATBM	anti-theater ballistic missile
ATD	advanced technology demonstration
ATR/ATC	automatic target recognition/classification
BDA	bomb damage assessment
BMDO	Ballistic Missile Defense Organization
C3I	command, control, communications, and intelligence
CEP	circular error probable
CVBG	carrier battle group
DCA	defensive counter air (mission)
DGZ	designated ground zero
DPB	Defense Policy Board
ELINT	electronic intelligence
EMP	electromagnetic pulse
EPW	earth-penetrating weapon
FOC	full operational capability
FoV	field-of-view
FSU	former Soviet Union
GLCM	ground-launched cruise missile
GPS	Global Positioning System
HALE	high-altitude long-endurance

HUMINT	human intelligence
ICBM	intercontinental ballistic missile
IMINT	imagery intelligence
INS	inertial navigation system
IOC	initial operational capability
JDAM	joint direct attack munition
JSOW	joint stand-off weapon
LGB	laser-guided bomb
MaRV	maneuvering reentry vehicle
MIRV	multiple independent reentry vehicles
MRC	major regional contingency
MR/IRBM	medium-range/intermediate-range ballistic missile
MTI	moving target indicator
NCA	National Command Authority
NPR	nuclear posture review
NSNF	nonstrategic nuclear forces
NTM	national technical means
OCA	offensive counter air (mission)
OSI	on-site inspection
PGM	precision guided munition
RDT&E	research, development, test, and evaluation
SEAD	suppression of enemy air defenses
SIOP	Single Integrated Operations Plan
SLBM	submarine-launched ballistic missile
SOF	special operations forces
SRAM	short-range attack missile
SSBN	ballistic missile submarine
S&SS	Strategic and Space Systems
STRAT-Y	strategic planning exercise
TBM	theater (or tactical) ballistic missile
TCT	time-critical target
TEL	transporter-erector launcher
THAAD	theater high-altitude area defense
TLAM	Tomahawk land attack missile

TMD	theater missile defense; tactical munition dispenser
TSSAM	tri-service stand-off attack missile
UAV	unmanned air vehicle
UGS	unattended ground sensor
WAM	wide-area mine
WMD	weapons of mass destruction

Chapter One

INTRODUCTION

This report summarizes work performed by RAND and its subcontractor, Defense Group, Incorporated, to gain a long view of possible directions for what have traditionally in the U.S. defense community been labeled "strategic forces"—recognizing that we are in the midst of a dramatic and historically profound change in the U.S. strategic environment. The study was thus undertaken and designed in the anticipation that in response to this new strategic environment the Department of Defense (DoD) might well develop and promote new strategic forces research and development (R&D) and acquisition initiatives to be pursued by defense agencies and the Services.

In the Strategic and Space Systems (S&SS) context, "strategic forces" refer to the long-range delivery platforms over which that office has traditionally had cognizance: ICBMs, SLBMs, and long-range bombers. Except for the dual-capable bombers, these weapons platforms up to now have been exclusively nuclear delivery systems—the U.S. nuclear triad—a deterrent against Soviet nuclear threats to the homeland and the bulwark of the United States' extended deterrent in support of regional allies. As described in this report, the new strategic environment suggests the prospect of other strategic roles for these systems, in support of the U.S. regional strategy for thwarting would-be regional hegemons and in support of U.S. nonproliferation objectives.

Our task was as follows:

- Assess the new strategic environment, looking well beyond the expected near-term completion of the strategic forces modernization programs initiated in the late 1970s and early 1980s.
- Present a vision of that longer-term future that will help the DoD develop and implement START I and II build-down strategies in a fashion that best meets U.S. long-term national security needs.
- Anticipate new problems that may emerge for which new strategic delivery systems—or even a whole new generation of such systems—might be required.
- Identify candidate strategic system R&D and acquisition initiatives responsive to this spectrum of future needs.

BACKGROUND

The study was designed to help S&SS both inform and respond to an evolving requirements process. The principal motivating force for the study was the end of the Cold War; however, it is clear that the internal dynamics in the former Soviet Union (FSU) are such that there may be a long period of uncertainty (years, if not decades) regarding the strategic nuclear threat that Russia (possibly in concert with other FSU republics) poses to the United States and its allies.

If we broaden our view of other possible "strategic" threats to the United States and its allies and address the proliferation of nuclear and other weapons of mass destruction (WMD), the strategic threat picture gets both more complex and cloudier, not the least because it becomes bound up with "regional strategic" constructs. For example, the nascent nuclear arsenals of emerging potential U.S. regional adversaries will assuredly be strategic (though from our vantage point, "regional strategic") in their conception, in their brandishing, and in their use as warning or electromagnetic pulse (EMP) shots. In thinking about such regional strategic contexts, one might even argue that, say, the first ten weapons a nation acquires are all "strategic." This may also be true of the first 100 nuclear weapons in an arsenal, since even if some of these weapons are tactical in design and delivery, they will have strategic impact in a calculated move on a regional strategic chessboard. In this situation, requirements for

U.S. military capabilities that once fell neatly into strategic and tactical categories now become interrelated.

Although the specifics are inherently uncertain, the trends seem clear. It seems almost certain that over the next 25 years (the time frame for this study), we will see:

- Continuing reductions in U.S. and Russian strategic nuclear arsenals.
- An increase in the number of states, or even transnational factions or terrorist groups, armed with weapons of mass destruction and in many cases modern means of delivery such as ballistic missiles (although unconventional means of delivery may also pose a serious threat).
- An increase in the number of states that choose (possibly as a consequence of treaty restrictions) to maintain "virtual nuclear arsenals"—arsenals that capitalize on the existence of a nuclear infrastructure and access to nuclear materials sufficient to produce covertly (at least by existing inspection standards) a regionally significant strategic nuclear arsenal in a time period on the order of weeks or months.
- Proliferation of high-tech weapons systems such as air defenses, antiship missiles, theater ballistic missiles, and the like that will increase the risk to U.S. air and sea power projection assets.
- Increasing emphasis in the United States (and likely elsewhere) on advanced conventional weapons (and, though less likely, "usable" nuclear weapons) to deter and otherwise deal with regional aggression.
- Less day-to-day forward deployment of troops and materials on bases in foreign territory.
- Increasing opportunity for effecting a multinational approach to world and regional security through diplomatic, economic, and/or military means.

In general, the world, from political, economic, and military perspectives, will become more complex and multipolar. The United States will likely remain the preeminent great power, but it will find it in-

creasingly costly and risky to influence world events to the degree it once did.

Without the context and motivation of the Cold War stand-off with the Soviet Union, large new investments in traditional strategic and theater nuclear systems can no longer be justified. While the United States will have to maintain a capable, safe, and secure nuclear deterrent for the foreseeable future, the trend clearly will be to build down rather than up, with U.S. and former Soviet strategic forces already scheduled to be retired (under START I and II). Operational requirements are being relaxed and the programs for long-range strategic nuclear force modernization begun in the Carter and Reagan administrations are nearly complete.

Furthermore, for the first time since the start of the Cold War, the United States has *no* follow-on strategic systems in any stage of development. Although the Russian strategic forces modernization program is less clear, the fiscal crisis there will assuredly reinforce the inertia within the strategic forces infrastructure.

The long-term goal of this study was to develop alternative strategic plans for the traditional strategic delivery systems—ICBMs, SLBMs, and long-range bombers, derived from a careful examination of the demands that could emerge in today's context.

These issues are of critical importance as the United States reacts to the dramatic changes in Russia and the other former Soviet republics. There are opportunities for a safer, more stable strategic posture vis-à-vis Russia at greatly reduced force levels, but the specifics on managing the draw-down and providing contingency options against nontrivial threat uncertainties have yet to be developed. That these plans and disengagement concepts should be lagging recent events is no surprise given the pace of political change. Nevertheless, if the United States is to make the most of this opportunity, we must draw down our strategic forces wisely, maintaining them and modernizing them as appropriate while laying the foundation for the future by stimulating and directing R&D initiatives and ensuring the viability of core reconstitution capabilities. The challenge is to maintain a focus on these critical issues of national survival absent a manifest threat.

STUDY APPROACH

As shown in Figure 1, the study team's approach in addressing these issues was to take a top-down "strategies-to-tasks" perspective[1] to derive new or revised strategic tasks from higher-order national objectives and military strategies. As argued above, in terms of the "residual deterrence" mission vis-à-vis Russia as the inheritor of the Soviet strategic nuclear arsenal, the basic character of the strategic tasks (e.g., holding at risk high-value targets in Russia and China) is not likely to change, although quantitative criteria are certain to be relaxed. In contrast, the strategic tasks that emerge from consideration of objectives and strategies related to the challenge posed by, for example, nuclear-armed regional adversaries (e.g., time-urgent conventional counterforce capability to aid in neutralizing a regional adversary's nuclear arsenal) pose a daunting new challenge for U.S. strategic forces.

In parallel, the team also worked from the bottom up, identifying new systems, operational concepts, and supporting technologies that might enable new strategic capabilities. The focus of this bottom-up approach was prospective new missions for strategic forces using counterforce against nuclear-armed regional adversaries. As such, the bottom-up examination looked for capabilities that would ensure high-confidence target acquisition (e.g., covertly deployable unattended ground sensors to detect and track medium-range/intermediate-range ballistic missiles [MR/IRBMs]) and prompt target kill with minimum collateral damage (e.g., conventionally armed highly accurate ICBMs or SLBMs).

As shown by the arrows in Figure 1, there is a difficult gap to close in the middle between the top-level "requirements pull" and the bottom-up "technology push." This gap is kept open by budgetary pressures and roles and mission tensions. We attempted to close this gap via a third study thrust: a planning exercise in which participants—operators (U.S. Strategic Command [USSTRATCOM]), developers (the Services, Office of the Secretary of Defense [OSD] and DoD agencies such as the Defense Nuclear Agency [DNA] and the Advanced Research Projects Agency [ARPA]), and members of the

[1]See Glenn A. Kent, *A Framework for Defense Planning*, RAND, R-3721-AF/OSD, 1989, and David E. Thaler, *Strategies to Tasks*, RAND, MR-300-AF, 1993.

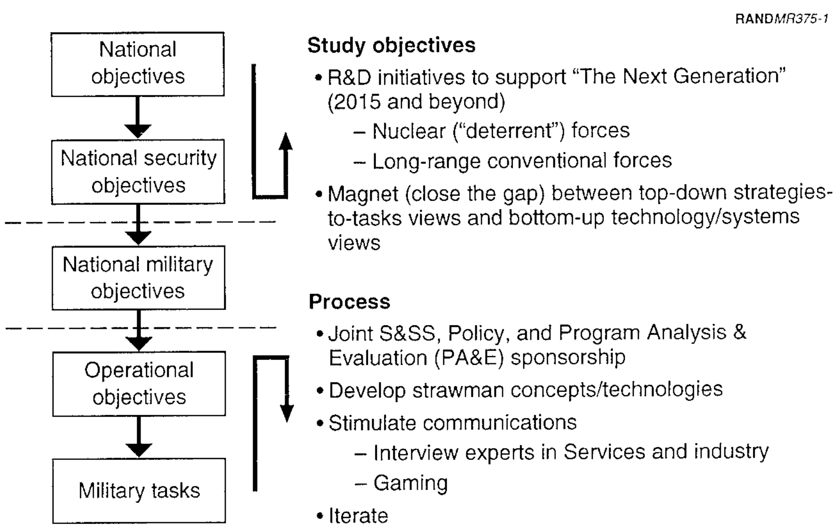


Figure 1—A "Strategies-to-Tasks" Approach to Deriving New Strategic Tasks from Higher-Order National Objectives

intelligence community (Central Intelligence Agency [CIA], Defense Intelligence Agency [DIA])—were challenged to chart possible U.S. response options in an escalating regional nuclear crisis (a 2003 Persian Gulf crisis) and to then reflect on this experience in terms of a possible investment strategy for strategic forces. The exercise was designed to give participants insights as to the problems our leaders might face in such crises and to begin to judge the possible utility of selected new strategic forces initiatives in comparable future contingencies.

The study team reviewed and met with the leaders of other work being done in this area.[2] The study team also benefited from visits with

[2]These other efforts included (1) the Defense Policy Board's Task Force on the Future of American Nuclear Weapons, (2) the Precision Strike and Global Surveillance initiatives; 3) USSTRATCOM's Force Posture Study, (4) the Air Force's Bomber Road Map, and (5) the Navy's STRATPLAN 2010 Study.

aerospace industry leaders and interviews with previous S&SS directors.[3]

CONVERGENCE: A HYPOTHETICAL EXAMPLE

The project's three strands of research converge in pointing toward R&D initiatives that will support fundamental strategic goals, exploit existing technological opportunities, and help address political and operational problems likely to emerge in the new strategic environment.

To choose a hypothetical example: The top-down research highlighted the need for mission capabilities to perform a number of tasks aimed at preempting WMD threats. One of these is destroying enemy mobile missile forces. The bottom-up research identified relevant opportunities afforded by strategic technologies: long-range capability, which permits force application from outside a regional theater; the short flight time for ICBMs and SLBMs, which (when supplemented by sufficient intelligence) could destroy key strategic targets such as dispersing mobile missiles and nuclear weapons that are moved frequently for survivability; surprise potential that is a by-product of the ability to strike without massive and visible force deployments; and the minimization of casualties enabled by stand-off attacks. The policy exercise confronted participants with the military option of launching a preemptive strike against Iranian nuclear WMD. Though the participants did not reach consensus on the advisability of doing this, there was some agreement that "Scud hunting" is not a serious option at present, since the United States does not have adequate capability for doing so.

These points converge in suggesting research into the use of ballistic missile conventional weapons to preempt mobile WMD. Areas in which continuing or expanded research may be called for include:

- Target acquisition: Very low observable covertly deployable unattended ground sensors, high-altitude long-endurance aircraft, satellite-based radars and multispectral sensors, and covert

[3]Dr. Lawrence W. Woodruff, Mr. T. K. Jones, and Dr. Seymour L. Zeiberg.

tagging for continuous surveillance in the light of strategic warning.

- Payload development: Maneuvering reentry vehicles capable of in-flight update on target location, conventional and nuclear earth-penetrating weapons, and EMP weapons for attack of dispersing forces and command, control, communications, and intelligence (C3I) nodes.
- Mission planning: Systematic assessment of timelines and coordination with regional forces for preemptive attack and immediate follow-on military action.

ORGANIZATION OF THIS REPORT

Chapter 2 presents the results of our top-down, "strategies-to-tasks" analysis. Chapter 3 discusses our bottom-up analysis of technological opportunities. Chapter 4 discusses promising R&D initiatives that synthesize the needs and the opportunities identified earlier and outlines directions for future research.

Chapter Two

STRATEGIES-TO-TASKS: A TOP-DOWN PERSPECTIVE

This chapter describes and adapts a generic "strategies-to-tasks" methodology to this study and then applies that methodology to the emerging strategic environment both to assess the ongoing evolution of the residual strategic nuclear deterrence mission and to identify those new future "regional strategic" missions that might be carried out by adapted or newly developed responsive strategic forces.

STRATEGIES-TO-TASKS METHODOLOGY

An appropriate first step in this type of undertaking is to ground the analysis in a classic "from first principles" or "top-down" approach. When such an assessment (and resulting decisions) can convincingly be argued as likely to stand the test of time, it is more likely that the derivative R&D and acquisition programs will be sustainable over time since the framework connects them clearly and explicitly to accepted needs and priorities. This has been the approach taken, for example, in the President's National Security Strategy Statement, the Posture Statement, and the Defense Planning Guidance. With this perspective in mind, Figure 2 provides a schematic for a classic strategies-to-tasks approach, much like that used by the Air Force in its planning.[1]

The branching under each of the steps arrayed along the left side of Figure 2 implies the existence of a multiple set of pathways along

[1]See Glenn A. Kent, *A Framework for Defense Planning*, RAND, R-3721-AF/OSD, 1989.

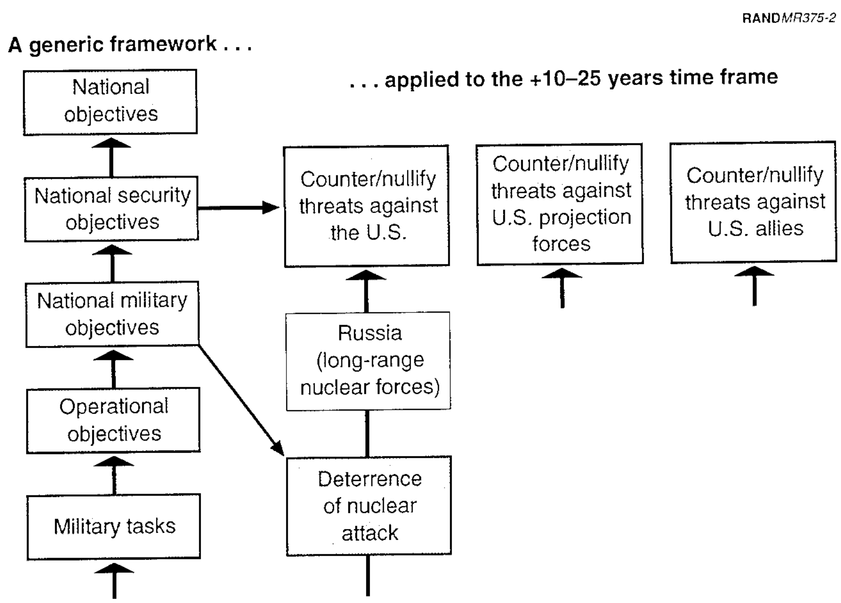


Figure 2—A "From-First-Principles" Methodology Schematic

which to proceed. For example, under "National security objectives" there are logically independent "National economic security" and "National social security" objectives. The analysis in this project follows paths that represent threats to the "Physical security" of the United States, its forces, and its allies, along the dimensions shown to the right in the figure.

Figure 3 picks up the strategies-to-tasks framing at the "Military tasks" level and presents the logically sequential questions regarding force levels and capabilities: Do we have the forces/capabilities to carry out the conceptualized military tasks that emerge from the top-down approach? If not, what R&D initiatives might yield such forces/capabilities? The break in the Figure 2/Figure 3 top-down framework at the military task level is deliberate, reflecting that at this point the top-down logic casts forth the call: "Is there anything out there that might do this conceptualized task?"

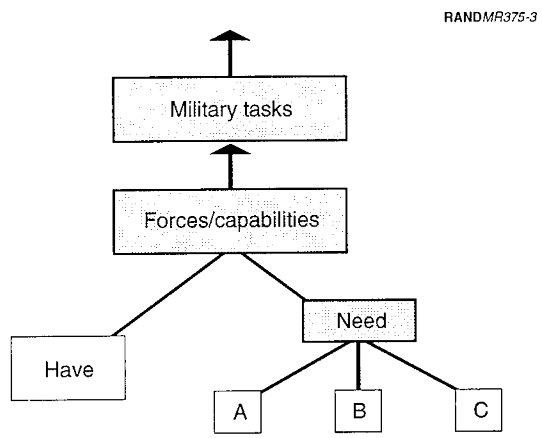


Figure 3—From Military Tasks to R&D Initiatives

Figure 2 portrays the current manifestation of the former Soviet nuclear threat and our response countering the nuclear threat to the United States posed by Russia's long-range nuclear forces through a policy of deterrence based on the threat of massive retaliation against high-value Russian military and civilian targets. The particular military tasks that underlie or whose potential execution would satisfy this operational objective include being able to locate and destroy in retaliation: (1) transportation nodes, C3I facilities, and supporting airfields for Russian general-purpose forces, (2) key manufacturing and C3I facilities for long-range nuclear forces, and so forth. It is generally assumed that some subset of current U.S. strategic nuclear forces will be adequate to deter Russian nuclear attacks for the foreseeable future. As discussed below, the key hold-at-risk criteria for this residual deterrence mission are being reexamined.

When looking at the national security objective of countering or nullifying possible threats against U.S. projection forces and threats against U.S. allies, a new set of potential threats and possible responses appears, as portrayed in Figure 4. In such situations, as shown in the figure, a wider set of possible national military objectives appears. In a sense, this is a policy options menu that has not

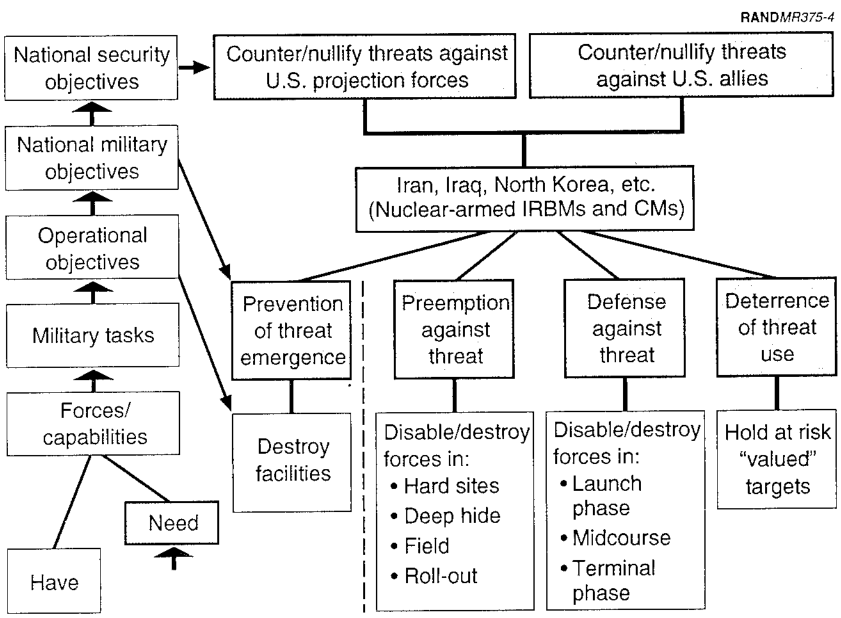


Figure 4—"Strategies to Tasks" Applied to a Possible Regional Threat

as yet been acted on—with the clear option of choosing "all of the above" as a policy decision. On one side of the spectrum, as indicated by the vertical dotted line, there are potential objectives that predate the threat reaching deployment or initial operational capability (IOC)—preventing the threat from emerging. At the other end is classic deterrence (but in this context, not necessarily based exclusively, or maybe even at all, on nuclear weapons). Between are the preemption and defense options, which in some circumstances might be judged independently and in others operating in concert.

Flowing down from "National military objectives," Figure 5 presents a set of "Military tasks" that might emerge from examination of the preemption option and implied "R&D needs" considering the current absence of such capabilities. (The challenge of remedying these needs to accomplish the identified tasks—in the context of a campaign that might be carried out to counter the mobile ballistic missile

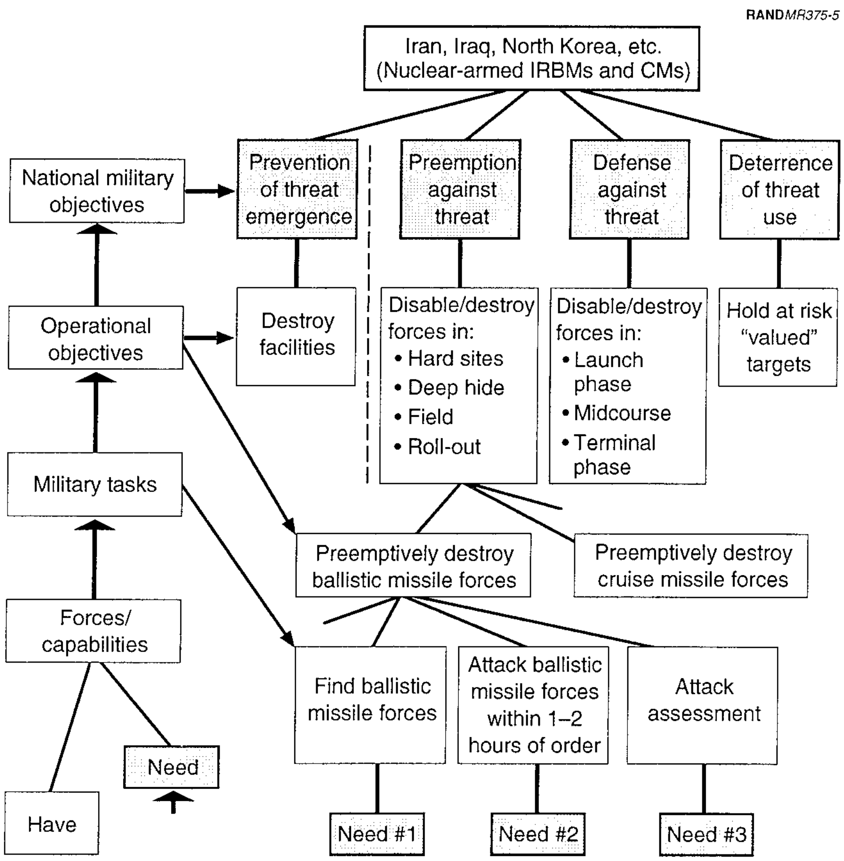


Figure 5—Exemplary R&D Needs Derived from Objective of Achieving Conventional Preemption Capability

forces of a future U.S. regional adversary armed with nuclear weapons—is addressed in the next chapter.)

The logical progression described above was applied to both the evolving Russian threat and to a full range of potential threats to U.S. projection forces and regional allies. The following general observations derived from the strategies-to-tasks analyses were used in this study to underwrite our initiatives:

- Nuclear forces will remain an important part of our military posture for the foreseeable future as a minimum as a "residual deterrent." As a consequence, we must (1) plan for their suitable replacement as they wear out, (2) modernize those elements where foreign threats endanger that force's effectiveness, and (3) nurture a technology base (and with it an industrial infrastructure) capable of responding to future needs in a timely manner.
- A reemerging hostile Russia (or its equivalent), armed with a substantial number of nuclear weapons, is a threat we must take seriously, and is a prospect against which, for the foreseeable future, we should plan.
- A far more likely threat, and one of almost certain greater consequence for overall U.S. national security planning, is the proliferation of weapons of mass destruction, particularly the proliferation of nuclear weapons. Possible new nuclear-armed countries include some of the most likely U.S. adversaries in the major regional contingencies envisioned in the U.S. regional security strategy. Clearly, the decision to deploy U.S. forces into a "nuclear-shadowed" environment under current planning assumptions will be exceedingly difficult to make, with significant consequences for U.S. power projection capabilities and coercive potential.

RESIDUAL DETERRENCE

As long as the United States faces the threat of nuclear annihilation, deterrence of that threat must continue to be our highest national security priority. However, looking to the future, a strategies-to-tasks top-down analysis of the residual deterrence problem vis-à-vis Russia tends to get bogged down as the military mission of "deterrence" is decomposed into supporting military tasks, against which tactics and systems can be evaluated. In such a situation, we face the fact that strategies-to-tasks works well to deeper levels in a decision tree only in situations where there are well-accepted higher-order goals and associated strategies. When, as seems to be happening now with respect to Russia, events get ahead of our vision and our "old think" goals and strategies no longer seem totally relevant, a rethinking of strategy and policy objectives must precede the revision of military missions, tasks, and systems.

In the material that follows, we first explore the opportunities for rethinking the U.S. residual deterrent posture in the light of the reductions and limitations of the START II agreement. We then address the prospect of establishing and achieving new and more far-reaching military and operational objectives in response to the evolving character of the U.S.-Russian relationship.

START I and II Draw-Down

In support of the Defense Policy Board (DPB) Task Force on the Future of American Nuclear Weapons, RAND, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory addressed issues of nuclear dealerting, monitoring, and warning that have arisen as a consequence of the START II agreement (see the Appendix). The process of decreasing inventories from Cold War levels to the START II levels of several thousand strategic nuclear weapons on each side will take a decade or so, in part as a consequence of limitations in the capacity of facilities to store weapons and to dismantle them. Figures 6 and 7 give some feel for the scope of these force draw-downs.

RAND*MR375-6*

United States		Russia	
500 de-MIRVed MM-IIIs x 1 =	500	400 SS-25s x 1 =	400
18 Trident boats: 18 x 24 x 4 =	1,728	6 Typhoons: 6 x 20 x 10 =	1,200
		7 Delta IVs: 7 x 16 x 3 =	336
No B-1s[a]		20 Blackjacks x 12 =	240
20 B-2s x 16 =	320	36 Bear H x 16 =	576
95 B-52Hs x 10 =	950	27 Bear H x 6 =	162
Total:	3,498	Total:	2,914

[a]B-1 conventional only (no cruise missiles); limit: 100 conventional bombers.

Figure 6—Nominal Projected Force Posture Under START II

RANDMR375-7

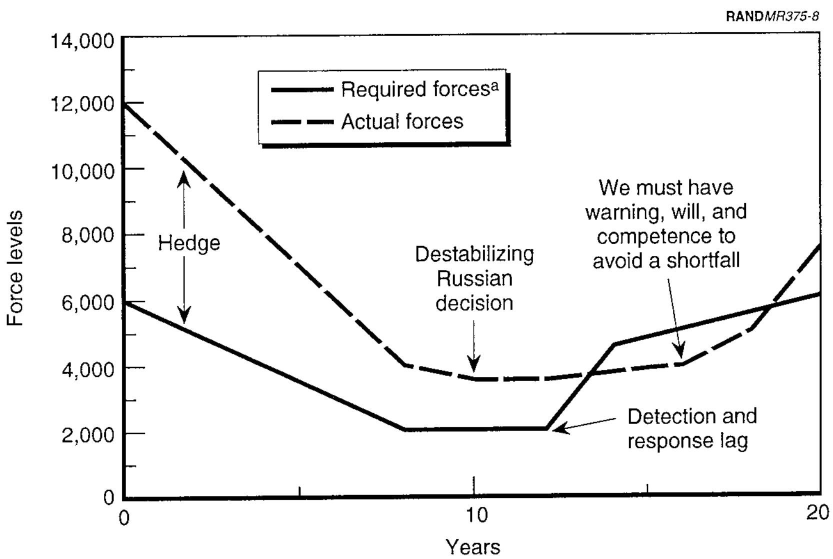
	United States	Russia
To be eliminated:	49 B-52Gs (Pen) 96 B-52Gs (ALCM-B)	84 Bear A/B/G/H
	450 MM-II 50 Peacekeeper	366 SS-11/13 (1 RV) 47 SS-17 308 SS-18[a] 300 SS-19 56 SS-24 (silo) 33 SS-24 (rail)
	24 Poseidon boats	12 Yankee I SSBNs 37 Delta I, II & III
To be converted:	95 B-1B (conventional)	(84 Bear A/B/G/H?)
	De-MIRV 500 MM-III	
	De-MIRV (8 to 4) 432 Trident SLBMs	De-MIRV (4 to 3) 112 SS-N-23
To be added:	20 B-2s	5 Blackjack
	6 Trident boats & D5s	112 SS-25 (1 RV)

NOTE: ALCM = air-launched cruise missile.

[a]90 SS-18 silos may be converted for smaller single-RV ICBMs, but all SS-18 missiles must be destroyed.

Figure 7—Nominal Projected Force Posture Changes Under START II

The DPB asked RAND and our laboratory associates to develop and evaluate strategic dealerting concepts to further this process, with particular emphasis on evaluating the monitoring and warning implications of these dealerting options. Given the dynamic and uncertain political environments within the former Soviet republics, the DPB concern, as shown notionally in Figure 8, was with our ability to respond to unanticipated changes in Russian force status with a *quantitative* increase in alert nuclear weapons. This does not suggest that our response to strategic warning or detection of a Russian buildup and/or breakout would necessarily be a quantitative increase in alert weapons. The development and deployment of new generations of reentry vehicles, for example, maneuvering reentry vehicles (MaRV) and/or cruise missiles that enhance penetration performance, are an obvious alternative. We may also be in a situa-



[a]Force size requirements are a function of Russian nuclear forces, Russian military capabilities (a determinant of U.S. targeting requirements), and U.S. hedging.

Figure 8—U.S. Response to Unanticipated Changes in Russian Force Status

tion where there is domestic political opposition to a significant buildup of alert nuclear weapons as an immediate response. Constraints imposed under a next generation of nuclear arms control treaties that includes parties other than the Russian Federation (e.g., a "START III" agreement with further reductions that includes China, Britain, and France) may also argue for responses other than arsenal expansion.

There are many sound reasons to dealert or otherwise disengage nuclear forces much sooner than might be called for under the START agreements. (Disengaging nuclear weapons entails dealerting nuclear forces, and in the context of this report the terms "disengaging" and "dealerting" will be used interchangeably.) Meaningful disengagement of these forces will expedite—and politically serve to further lock in—the arms reduction process. With fewer weapons on alert, the risk of accidental or unauthorized use of nuclear weapons

will be lessened. If the weapons to be disengaged sooner included MIRVed (independently targeted) ICBMs in silos, which constitute vulnerable, lucrative targets for a first strike, crisis stability could be enhanced (assuming reliable second-strike forces are maintained, and reengagement of disengaged forces is observable). Finally, early disengagement provides an opportunity to posture nuclear weapons so that they are both safer and more secure.

While the United States and Russia dealert strategic nuclear forces, it is important that certain constraints be satisfied. These constraints center around the necessity for the United States to maintain adequate strategic nuclear forces and the capability to generate additional forces, so that national security is resilient to new threats that may arise. In particular, the United States must maintain adequate deterrent forces on alert; be able to respond in a timely fashion to the emergence of a resurgent, aggressive Russia through, for example, the realerting of some forces; and maintain the core technical competencies necessary to build additional forces, if necessary.

The United States faces a number of challenges as strategic nuclear forces are reduced under the START I and II agreements. At the START II level (nominally an inventory of 3500 weapons), U.S. strategic nuclear force retaliatory capabilities closely match perceptions of minimum requirements from the recent past—an ability to hold at risk in retaliation the bulk of Soviet "other military targets" (OMT), C3I targets, and military-related urban/industrial (U/I) targets. This effect can be seen quantitatively in Figure 9 by comparing 1991 weapons and target sets with the 2003 cases for the United States and Russia. The minimum force level for a suitably hedged deterrent force in the longer term remains to be determined. While many strategists accept the START II goals as well above the minimum, it remains to be seen whether there is a significantly lower level that might be appropriate to a new strategic nuclear equilibrium state in which (1) there is greater confidence in Russia's stability and global posture, and (2) the other nuclear-armed nations also commit themselves to reduced ceilings on their nuclear arsenals.[2]

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[2]See Paul K. Davis (ed.), *New Challenges for Defense Planning: Rethinking How Much Is Enough*, RAND, 1994, for various perspectives on these issues.

RANDMR375-9

Time frame	Number of weapons					Number of DGZs				
	Inventory	Arriving								
		Day-Day B-F-T-B	Day-Day Ride-out	Gen 1st	Gen Ride-out	NUC	OMT	C3I	U/I	Total
U.S. 1991	13,000	6,000	4,000	8,700	7,000	1,500	1,500	500	500	4,000
	(50% in SSBNs)									
USSR 1991	11,000	6,000	1,500	8,200	4,000	1,500	1,000	200	300	3,000
U.S. 2003	3,500	900–1,500	900-–1,200	2,300	2,000	500	1,200	300	300	2,300
	(SL only - SL+IC+B)					(Less silos)		(Russia vs. USSR)		
Russia 2003	3,000	400–700	400–600	2,500	2,000	1,000	1,000	200	300	4,000

For U.S.: Day-Day 1st-Strike (Bolt-from-the-Blue):
Arriving = 0.85 x (alert ICBMs + alert SLBMs + 0.7 x alert bombers);
Generated 1st-Strike (Preemption):
Arriving = 0.85 x (0.95 x ICBMs + .85 x SLBMs + 0.9 x 0.7 x bombers);
Day-Day 2nd-Strike (Ride-out):
Arriving = 0.85 x (0.1 x alert ICBMs + alert SLBMs + 0.7 x alert bombers) ;
Generated 2nd-Strike (Ride-out):
Arriving = 0.85 x (0.1 x ICBMs + .85 x SLBMs + 0.9 x 0.7 x bombers);
same for Russians except 100% bomber penetration and 100% survivability for mobile ICBMs.

Figure 9—Comparison of 1991 Weapons and Targets with the 2003 Cases for the U.S. and Russia

A substantial disengagement of nuclear forces will affect the U.S. strategic posture in several ways. First, because it takes longer to dismantle forces than to dealert them, dealerting would result in a quicker drop in force levels. Second, the dealerting process could foster a more cooperative relationship between the United States and Russia, which could lessen the possibility of untoward Russian behavior in the future. Finally, if superpower relations sour before weapons have been dismantled, Russian reengagement of dealerted forces would provide visible evidence of a change in the character of the Russian state and a clear signal to which the United States can respond by realerting its disengaged forces (and be no worse off than if the forces were never disengaged).

If the deterioration of the superpower relationship occurred after dismantlement of forces under the START agreements, the ability of the United States to respond would depend on its reconstitution capability.

In this study, RAND and the nuclear laboratories identified several disengagement ideas worthy of further consideration. Some examples of the dealerting and restraining disengagement concepts addressed by the team (and recommended for further development by the Services and intelligence and aerospace communities) are shown in Figure 10 for ICBM systems.[3]

Given the stakes involved, the defense community needs to work out the details on the overall disengagement question, including explicitly addressing goals to be achieved. For example, what are reasonable disarmament, disengagement, rearmament, and reengagement "measures of effectiveness"? In this context, there are important nuclear strategy and policy issues to consider beyond the numbers game of SALT and START I and II. Military roles and missions must be examined, as well as the technical, scientific, and manufacturing infrastructure (people and facilities) necessary to support various strategy and policy needs. U.S. leadership will then need to clearly and convincingly articulate these visions so that they will be supported and implemented effectively.

Modernization

When longer-term nuclear force requirements are considered, planners must deal with a new set of questions, including: Where should the United States and the rest of the world be heading with regard to building or retaining nuclear inventories in the future? We offer the following observations based on our strategies-to-tasks review:

- The nuclear genie cannot be returned to its bottle. Even if it were possible to completely eliminate all the warheads, the ready availability of plutonium and the ease of production of highly

[3]A more detailed assessment of these concepts and those examined for the other Triad systems can be found in the Appendix.

RANDMR375-10

Concept	Monitoring	Generation Time	Safety and Security	Stability	Survivability	Afford-ability	Trans-parency
Remove launch keys and codes, targeting data	None	Hours	Central control	No effect	No PRL in B-F-T-B, key vuln?	No cost	None
Barrier over silo door	NTM	Weeks–months	No accidents, less risk of unautho-rized launch	Crisis transition problems	As above plus post-attack generation?	Modest (TBD)	Yes
Spacer between RV platform and missile or defuel missile	NTM/ OSI	Weeks–months	Secure RV storage, no accidental launch	As above	As above	Little expense	With OSI
Detarget	None	Minutes	Less risk of accident/ unautho-rized launch	No effect	PRL in B-F-T-B?	No cost	None
Remove shroud	NTM/ OSI	Weeks	As above	Crisis transition problems	No B-F-T-B PRL, vuln of generation assets	Modest (TBD)	With OSI

NOTE: NTM = National Technical Means.
OSI = On-site inspection.
B-F-T-B = Bolt from the Blue.
PRL = Prompt retaliatory launch.
TBD = To be determined.

Figure 10—ICBM Dealerting and Restraining Concepts for Further Development

enriched uranium ensure that nuclear weapons will perpetually cast a strong shadow on international security affairs.

- Barring unforeseen changes in current trends, in coming decades more countries rather than fewer will possess either at-the-ready nuclear arsenals or consciously planned "virtual" nuclear arsenals that can be brought to an at-the-ready state in a matter of weeks or months, depending on a nation's concept of its likely strategic warning time.

- Neither the United States nor Russia is likely to shrink its nuclear weapons inventory to a size anywhere close to that of the third largest nuclear power (presumably a future China). However, further reductions in U.S. and Russian nuclear arsenals beyond START II levels as part of a future multiparty nuclear arms control regime should not be ruled out.
- Some modernization or replacement of long-range strategic nuclear weapons will be needed, simply because weapon systems wear out.
- Some modernization could be desired because new threats could emerge that change or broaden U.S. nuclear employment policy.
- Some modernization will be desired because new opportunities will emerge that either augment planned capabilities or open up options for beneficial new capabilities such as improved verification.

At present, USSTRATCOM has no requirements for strategic force modernization beyond the completion of the initiatives begun in the late 1970s and early 1980s. There are currently no new bombers, bomber nuclear weapons, ICBMs, survivable ICBM basing systems, SLBMs, or SSBNs under development in the United States, a situation unique in post–World War II history.

Conversion Opportunities for Retiring Nuclear Forces

The START II agreement calls for reductions in total strategic nuclear weapons to the 3000–3500 range, down from over 10,000 today. Wherever reasonable, the "decommissioned" nuclear weapon platforms will be refitted for other roles (i.e., not simply tossed away). Some bombers (B-1Bs) are already scheduled to assume pure conventional roles and missions. Ballistic missiles might become space launchers or target vehicles for antiballistic missile (ABM) tests. The older submarines might be reconverted to attack submarines, depending on the availability of resources.

Among the issues to be addressed are (1) are there conversions to conventional weapon systems that have strategic potential and should be pursued for that purpose? and (2) are there new munitions

that could be added to the residual weapon platforms that might provide new capabilities in the strategic arena?

COUNTERPROLIFERATION

With the collapse of the Soviet Union, the bipolar Cold War tension that both drove and was driven by the nuclear arms race is now gone. As a consequence, the world is experiencing both a new level of ethnic and religious turmoil that is fractionating nations once held together by the bipolar framework and a rekindling of long-dormant international competitions for regional hegemony. This process is likely to continue for the foreseeable future, with the emergence of new national entities, increasingly powerful transnational factions, and would-be regional hegemons who achieve a measure of ascendancy that threatens the independence of U.S. allies as well as other U.S. national interests.

The prospect of efforts at nuclear coercion by rogue states, transnational groups, and would-be regional hegemons is troublesome for several reasons. Regional strategic constructs could easily emerge in which the stable balance of terror that deterred the bipolar superpowers from engaging in direct military conflicts may no longer pertain. New and significant "asymmetries of stake" could emerge. For example, the United States and its allies or potential coalition partners in the Middle East are probably more vulnerable to nuclear weapons and nuclear threats than is Hezbollah or a totalitarian Middle East regime that does not enjoy wide popular support and is willing to sacrifice large numbers of its citizens to some political end. Thus, when U.S. national survival is not at risk, in spite of the existence of the U.S. nuclear arsenal:

- We run the risk of being deterred or coerced.
- We may not reasonably be able to expect to deter or coerce certain factions or countries.

In light of this situation, and because complete containment of the proliferation threat seems at this point unachievable, military counterproliferation initiatives must be pursued in parallel with a renewed and more robust commitment to traditional nonproliferation efforts.

The specific military counterproliferation tasks that emerge from a top-down approach to the WMD proliferation issue are still being defined. Military perspectives or approaches range from a "bloody nose" view (power projection as usual even under the threat of nuclear use: "They wouldn't *dare* use WMD against us and if they were so foolish as to do so we'd give it back to them in spades!"), to a search for "silver bullets" (systems such as near-perfect/zero-leakage theater missile defense [TMD] or the coupling of highly intrusive and sophisticated covert intelligence collection systems to rapid-delivery precision strike weapons), to a search for new power projection concepts and systems.

Part of the problem behind the lack of convergence on an overall counterproliferation strategy and supporting military and intelligence initiatives is the lack of a clear and common view of just what should be the dominant perspective on the problems created by increased nuclear proliferation. Candidate problem statements include the following paraphrased examples:

- Nuclear proliferation will make power projection so messy and fraught with uncertainty that nuclear weapons will become the great equalizer, enabling small countries (or even transnational groups) to gain leverage over the United States and its regional allies.
- Nuclear proliferation presents a moral dilemma: Can we forcibly prevent nations from acquiring nuclear weapons by attacking nascent nuclear weapons programs? Can we preemptively attack the nuclear arsenals of unfriendly nations absent direct provocation or outside some crisis context? Can we use nuclear weapons to take out the nuclear weapons of small regional adversaries if such weapons have not been used against the United States or its allies?
- Nuclear proliferation may reach a critical mass that cannot be controlled, leading to an unstable state and threatening nuclear anarchy.

These observations describe different perspectives on a complex problem. There is an urgent need for a far greater focus on the different facets of this problem, plus development of a keener sense of priorities. Without them, there is a real danger that decisionmaking

will be delayed and the United States will, in effect, flounder until the problem becomes so immediate and so extreme that it simply does not have time to respond effectively.

The role of the intelligence community in dealing with WMD proliferation is vital. As was the case in the Cold War for the Soviet Union—but now for a new and expanding set of nations—we want the community to provide everything from enemy strategic motivations and intentions, to strategy, doctrine, and tactics, to order-of-battle data, to system technical characteristics and capabilities, to real-time surveillance and targeting support to the commanders-in-chief (CINCs). But whereas the standards of the Cold War and a bipolar stand-off of thousands of nuclear weapons permitted a significant level of uncertainty in some of these parameters, the "tyranny of small numbers" and their impact on regional contingencies call for greater precision in many of these estimates from the intelligence community.

The military dimension is comparably demanding and complex. In fact, some proposed goals or solutions, such as "leak-proof" defenses, are almost certainly unrealistic for other than very small attacks. Other tasks, such as finding and destroying WMD or WMD launchers before they can be used, may never be confidently executed because of inherent operational and threat uncertainties and, especially, the absence of technological inventions sufficient to work all of the target acquisition problems that a savvy proliferator may present.

Nevertheless, there may be opportunities to develop and field new strategic systems (i.e., new long-range bombers and ballistic missiles and associated weapons) specifically to satisfy mission needs in regional conflicts that include WMD threats. To explore this prospect, we will assume that:

- All engagements in which there is a significant potential that weapons of mass destruction may be used against the United States or an ally have strategic implications. In the larger sense of the term, we assume that all conflicts in which we become involved—and all nuclear conflicts, independent of whether we become directly involved—will, by definition, have strategic implications.

- Although there may be potential opportunities for new types of strategic weapons to perform a broad range of strategic (as opposed to tactical) missions, our concern is on countering the effects of weapons of mass destruction.

Are there unique opportunities to address these needs? The key relevant features of the U.S. weapons we have labeled as "strategic" are:

- Long range, which permits force application from outside a regional theater and, in the limit, from the sanctuary of the continental United States.
- Short time of flight for ICBMs and SLBMs which, when supplemented by good intelligence, could hold at risk key strategic targets such as dispersing mobile missiles and nuclear weapons that are moved frequently for survivability.
- Surprise potential that is a by-product of the ability to strike without massive and visible force deployments. Surprise is enhanced by the speed and, in some cases, stealthiness of these systems.
- Firepower and lethality that permit widespread targets to be struck decisively and nearly simultaneously.
- In the case of ballistic missiles and cruise missiles launched from stand-off ranges, the potential loss of crews to defenses (with the further possibility that prisoners will be exploited) is all but eliminated.

To see more clearly the type of capability we are seeking, suppose that in a future Desert Storm type of scenario the enemy had a small number of nuclear weapons on medium-range ballistic missiles (MRBMs) that were being used to threaten a U.S. ally. Suppose further that the enemy has announced a deadline for meeting a set of conditions unacceptable to us, after which they threaten to use these weapons. Depending on the knowledge we have about the disposition of those MRBMs, their vulnerability, and the availability of forces in the area to attack (or defend) against them, our only viable preemption option may be with long-range ballistic missiles—preferably conventionally armed—if intelligence can support conventional targeting. We may not have the time necessary to generate

the needed aircraft sorties or to strike quickly enough with aircraft to prevent adversary use of these missiles.

Further, imagine a scenario in which, unlike in Desert Shield, we do not have the luxury of a six-month buildup and friendly regional infrastructure. Assume that the enemy has deliverable weapons of mass destruction that he threatens to use on our forces should we attempt to gain a foothold in the area. Do we stay home and give up on military responses to the crisis? Or are there military actions we can take from a distance—as depicted notionally by the phased "concentric circles" campaign concept in Figure 11—to deny the enemy's efforts to deter our intervention?

The four stages of such a campaign are envisioned as a progressive tightening of the power projection noose. What distinguishes one stage from the next is the type of system used to project power and the specific threat systems targeted. The power projection starts with long-range systems (e.g., bombers) based beyond the reach of enemy WMD strikes. As the longer-range enemy threats are contained, the noose is tightened, with forces projected to more forward

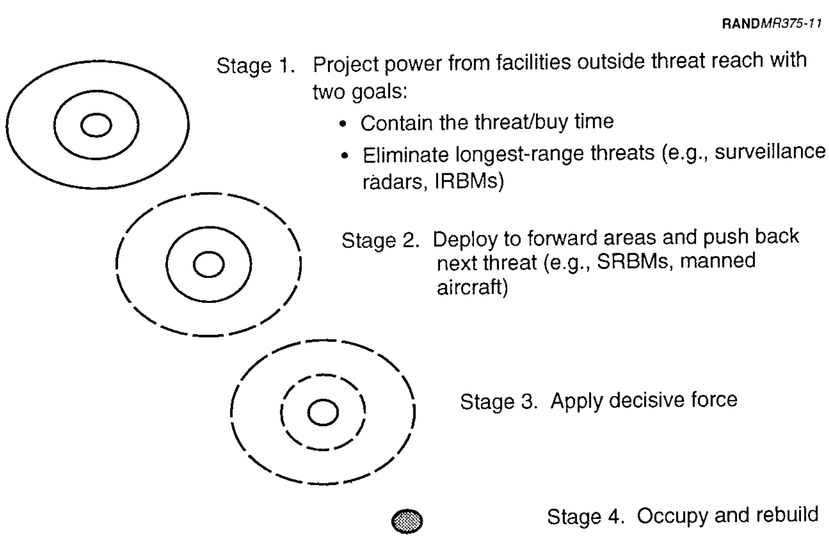

Figure 11—A View of the Possible Solution Space: The Concentric Circles

bases where they can be defended from the residual WMD threats. Finally, if required, the country would be invaded and occupied.

At each stage in such a power projection concept, the objectives would be to eliminate the threat of WMD. These objectives would be phased appropriately as the power projection stages progress. The objectives might be phased as follows in a nuclear weapons case:

Phase I. *Deployment and Defense.* In the first phase of the campaign, U.S. forces will begin deploying to the region in sufficient strength to conduct subsequent phases of the campaign. During this phase, the joint task force must guard against preemption by the adversary and must protect U.S. forces as well as allies in the region from nuclear attack. This phase includes gaining at least local air and sea control adequate to defend U.S. forces.

Phase II. *Destroy Nuclear Delivery Means.* In Phase II, which will require air superiority, the joint task force will begin offensive operations against the adversary to destroy all of his nuclear delivery means. Early aspects of Phase II may be conducted simultaneously with Phase I.

Phase III. *Destroy Nuclear Warheads.* The third phase of the campaign is the capture or confirmed disabling of all of the adversary's nuclear warheads and the destruction of all of his existing nuclear weapons-related production facilities. U.S. ground forces will be inserted to the extent necessary for positive assessment.

Phase IV. *Follow-On Operations: Removal of the Regime.* The joint task force may be asked to conduct operations to remove the adversary regime. Although this phase will not be an initial objective of the campaign, the joint task force should plan for possible follow-on operations to achieve the objective of removing the leadership of the country by whatever means necessary.

From an S&SS perspective, the most immediate issues in the consideration of such scenarios are not technical (lots of ideas have been proposed). Rather, the issues center around the national goals and strategies—and associated policies—to meet these evolving threats in plausible regional strategic scenarios. To gain a better appreciation for the issues involved in such scenarios, the study team devel-

oped and conducted a planning exercise with senior representatives from OSD, the Services, and intelligence community, as described below.

THE STRAT-Y PLANNING EXERCISE

It became clear from the top-down examination of the challenges that weapons of mass destruction (and especially nuclear weapons) posed to the existing U.S. strategy for dealing with major regional crises that convergence on a course of action for dealing with such threats would be extremely difficult. Facilitating informed discussion and debate within the leadership of the defense and intelligence communities on such matters—not just on overall goals and strategies and supporting policies but also on investment initiatives—was required. To facilitate and guide such a dialogue, the study team developed and ran a planning exercise, labeled STRAT-Y,[4] using a 2003 Middle East scenario to highlight the challenge of force projection in the face of a mature nuclear threat. The objectives of this planning exercise were to stimulate participants to:

1. Identify those military tasks or counterproliferation capabilities that the National Command Authority (NCA) would want to have available in crises such as those experienced in the planning exercise,
2. Conceptualize a candidate set of systems and concepts of operations to achieve these tasks or capabilities, and
3. Identify and prioritize an associated set of key enabling technologies and related R&D initiatives that would—if implemented and if successful—fundamentally improve U.S. counterproliferation[5]

[4]The STRAT-Y exercise drew its name from the touchstone 1967 STRAT-X study that explored the future of U.S. strategic nuclear offensive systems in unprecedented depth. STRAT-X was followed a year later by "STRAT-X Revisited," a more closely held study that explored the issue of strategic nuclear arms control in preparation for the 1968 Johnson-Kosygin Glassboro Summit.

[5]In this context, counterproliferation means responding to a major regional contingency in which our adversary possesses weapons of mass destruction, particularly nuclear forces.

capability along a path toward achieving the desired counterproliferation campaign capabilities.

STRAT-Y was designed to help the defense and intelligence R&D communities in developing and prioritizing initiatives to meet the extraordinary national and global demands attendant to crafting a viable long-term counterproliferation strategy and set of supporting policies. STRAT-Y focused in particular on the potential counterproliferation contribution of today's long-range strategic delivery vehicles—ICBMs, SLBMs, and long-range bombers. Two potentially important (and unique) roles for these systems were seen as sources of particular promise:

1. *Responsiveness*—no dependence on forward deployment and bases and, especially in the case of ICBMs and SLBMs, short flight times.
2. *Effectiveness*—a potential for (1) strategic and tactical surprise (a major consequence of the potential for very short times of flight), (2) high survivability and penetrativity (a consequence of, *inter alia*, speed, stealth, and stand-off capability), and (3) high lethality (an advantage gained from marrying the high-payload potential of these systems with improvements in accuracy and individual weapon lethality).

There was a strong particular interest in using STRAT-Y to assess the degree to which the United States might employ conventional weapons in place of nuclear weapons to meet certain emerging strategy and policy desiderata. For example, were there investments that would enable new mission capabilities for:

1. Preemptive strikes against WMD systems—forces and C3I—that the United States may face in scenarios such as the one presented in the planning exercise?
2. Rapidly deployable ballistic missile defenses over and above Ballistic Missile Defense Organization (BMDO) theater missile defense (TMD) projections?
3. Crisis and wartime surveillance of rear area WMD deployment areas?

The STRAT-Y planning exercise consisted of roughly six hours of on-site briefings and discussions/deliberations, preceded by exercise homework. STRAT-Y participants were general/flag officers and senior DoD and intelligence community civilians and advisors. Participants were divided into groups of ~10 individuals who engaged in a counterproliferation exercise within a nuclear proliferation scenario.

THE STRAT-Y METHODOLOGY

The scenario and basic methodology used in the STRAT-Y exercise were based on an ongoing Air Force project at RAND entitled "The Day After . . ." that examines the impact of further nuclear proliferation in the post–Cold War world. The particular exercise employed, "The Day After . . . in the Greater Middle East," examines a future Persian Gulf scenario in which the United States faces a hegemonic Iran armed with nuclear weapons.

"The Day After . . ." methodology itself is based on a three-step process that begins (see schematic in Figure 12) with an examination of the critical decisions confronting the United States—and in particular the U.S. President—on "the day of" a pivotal change in the nuclear *status quo* in some crisis context.

As a second pivotal point, the exercise turns to "the day after"—the aftermath of nuclear weapon use of some kind at a later point in the same crisis context—and explores the set of crisis-driven choices that would then face the U.S. President.

As a final decision point, the exercise moves to "the day before"—to the present—and considers the challenges to Presidential decision-making in *one or more* of the elements of:

- Crafting new policies and/or strategies,
- Designing new operational concepts,
- Launching new weapons R&D initiatives, or
- Launching new intelligence initiatives to enable the United States to help minimize the prospect that nuclear crises such as that just faced would occur—or, if they do, to mitigate their con-

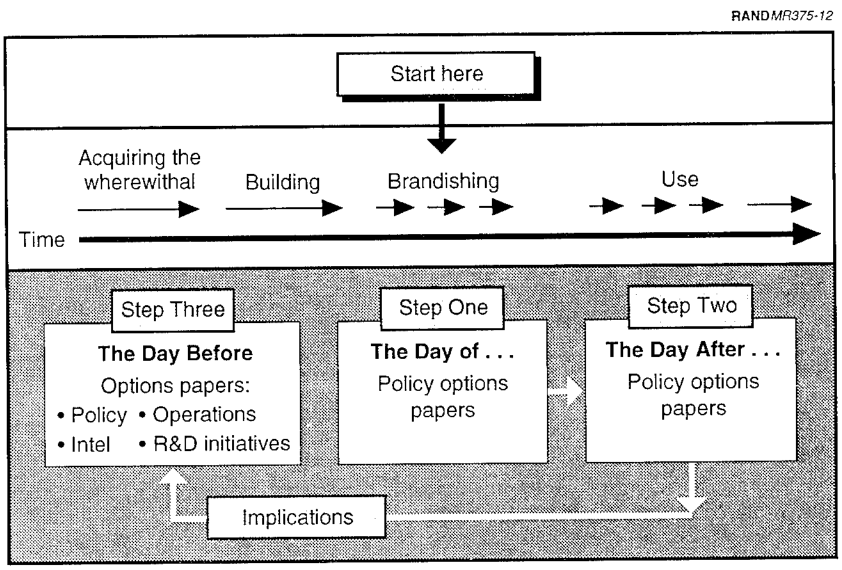

Figure 12—Methodology Schematic

sequences and reduce the likelihood that they would ever occur again.

Participants in "The Day After . . ." exercises took on the role of top advisors either to the President of the United States or to a National Security Council (NSC) principal in a group deliberative process akin to a classic time-urgent "pre-meeting" in advance of a formal NSC meeting with the President.

In both step one ("The Day of . . .") and step two ("The Day After . . .") of "The Day After . . . in the Greater Middle East," the group's task was to revise a draft of a memo to the President on the key issues to be taken up at an urgent NSC meeting on the 1999 nuclear crisis in the Greater Middle East in which Iran is threatening Kuwait.

In step three, the group's task—now back in the present—was to identify promising programmatic/weapon system initiatives to be included in a new investment strategy underlying a long-term approach to the nuclear proliferation problem.

The "Tool Box"

A major component of the STRAT-Y exercise (and a key part of the exercise homework) was a "tool box" of potential technological initiatives. This analytical device (described in more detail in the next chapter) was developed with the objective of highlighting those critical military "capabilities/tasks" that emerge in confronting challenging counterproliferation scenarios such as that presented in the STRAT-Y scenario. Examples include

- deep, wide-area/high-resolution surveillance
- precision strikes on deep time-critical targets
- delay and attrition of armored invasion forces
- counter leadership/C3I
- forward area (versus terminal) theater missile defenses.

The tool box sought to include with each critical counterproliferation task a description of a possible system and concept of operations—and related enabling technologies—that could render the identified task achievable. It was intended that the tool box serve as a repository of potentially useful ideas and as a stimulus and catalyst for new ideas.

In step three of the exercise, participants discussed the elements in the tool box and other technological concepts that might meet shortfalls identified in the exercise.

The STRAT-Y Scenario: "The Day After . . . in the Greater Middle East"

The scenario highlighted the kind of power projection problem that the United States would face in any major regional contingency (MRC) involving an adversary armed with a small arsenal of deliverable nuclear weapons. Of particular interest were:

- Nuclear deterrence might fail.
- Our tolerance for losses (ours and theirs) is limited.

  - *Any* nuclear use would have dire (but unpredictable) consequences.
  - We have a policy opposing first use of nuclear weapons.
  - The immediate threat to the continental United States (CONUS) is limited to unconventional attacks.
  - Forward deployed forces are inadequate and hostilities are imminent.
- The long-term consequences of failure to act are serious.
  - Regional instabilities or domination by hostile powers may result.
  - If proliferators win, proliferation increases.

The context for step one of "The Day After . . . in the Greater Middle East" is summarized below:

- Iran is the dominant Greater Middle East power, having defeated Iraq in a 1999 war. Iran has built up its military arsenal with aid from China and Russia and, in effect, is in a strategic alliance with China and Pakistan.
- Intelligence estimates that Iran has 20–40 nuclear weapons that could be deployed on either SRBMs, IRBMs, long-range bombers, or ground-launched cruise missiles (GLCMs).
- OPEC (Organization of Oil Exporting Countries) is in chaos over production cutbacks demanded by Iran.
- U.S. military forces have been reduced consistent with 1993 DoD force projections. There has been limited forward deployment of anti-theater ballistic missiles (ATBMs) (theater high-altitude area defense [THAAD] and Patriot PAC-III).
- In the week of September 9–16, 2003, several escalatory incidents take place. After a terrorist attack on an oil pumping station in Kuwait and Iranian movement of forces toward the Kuwait border, Kuwait mobilizes its forces. Border skirmishes ensue and a Kuwaiti F/A-18 is shot down by an Iranian SA-10.
- Iran then sends an ultimatum to Kuwait and Saudi Arabia demanding that these countries break ties with the United States,

declare their neutrality, and accept an Iranian nuclear security umbrella. At this point, Iran test fires three IRBMs with penetration aids that would negate the effectiveness of U.S. ATBM systems. There are also indications of an imminent Iranian decision to disperse nuclear weapons.

These incidents provide the context in which the participants are challenged to modify, in whatever way they see fit, a draft memo for the President outlining the key issues and options at an imminent NSC meeting.

The principal military options presented to the players for their consideration in this first step in the exercise are summarized in Figure 13.

In step two of the exercise, the participants find themselves two weeks later facing the following situation:

- GREEN HORNET and SILVER SABRE are approved and under way. There are escalating Kuwaiti/Iranian border skirmishes and

RAND*MR375-13*

Option	Assessment
Three-phase mobilization and deployment (GREEN HORNET/ SILVER SABRE) • 7 Army Div & 4 THAAD Div • 11 AF Air Control Wing • 6 Navy CVBG & 9 Aegis ships • 6 USMC brigades	• Several months of buildup required • Vulnerable during early phases • Capable of defeating Iran once buildup is complete • Iranian nucs could significantly increase U.S. losses
Preemptive air strike (IRON HAMMER) on WMD and selected C3I sites • Limited theater air • Long-range air (STRATCOM)	• WMD locations known (80–90%) in peacetime • Unknown when dispersed from garrisons • Could kill significant percentage of identified WMD • Problem areas: – Deployed > 1000 km from U.S. forces – Heavily defended – Hardened/underground storage – Limited surveillance of area

Figure 13—Military Options in Response to the Building Crisis (Step One)

air and sea battles in the region. U.S. ships are attacked with Iranian cruise missiles, resulting in 50 American fatalities.

- U.S. Navy aircraft respond, attacking and sinking several Iranian gunboats.
- At this point, Iran detonates an IRBM-launched 25-kt nuclear weapon high over the desert in southern Iran. Intelligence estimates that Iran will invade Kuwait within 12 hours.

The principal military options presented to the players for their consideration in the second step in the exercise are summarized in Figure 14.

The nature of the military tasks faced in these two steps is summarized in Figure 15.

As noted above, step three of the exercise was essentially a discussion of the elements that were in—or might be in—a tool box such as that provided in advance of the exercise.

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Option	Assessment
Delay and attrit (BLUE CYCLONE/ SUMMER LIGHTNING) • Attack surveillance, C3I, and NCA • Mine invasion approaches • Bomber attacks on advancing armor and mech divisions • OCA and DCA to control skies over Kuwait and Saudi Arabia • Close air support for indigenous ground forces • Air and ballistic missile defense – Attack operations – Active defense – Passive defense	• May buy time to finish implementation of GREEN HORNET/SILVER SABRE – Slow advance – Inflict significant losses • Unlikely to suppress the WMD threat completely – Iranians can escalate if things go bad – Nuclear deterrence uncertain
Forward deploy NSNF as a show of resolve, use against NCA if necessary	• What if deterrence fails . . . ?

NOTE: OCA = Offensive counter air.
DCA = Defensive counter air.
NSNF = Nonstrategic nuclear forces.

Figure 14—Military Options in Response to the Building Crisis (Step Two)

RANDMR375-15

Operation	Objective	Issues
1. IRON HAMMER	Preemptive strike against WMD systems	• Surveillance capabilities • Attack time lines • Warning denial • Lethality (buried) • Defense leakage
2. GREEN HORNET/ SILVER SABRE	Desert Shield-like forward deployment of defensive and offensive forces	• Long deployment time lines • Indigenous forces, forward bases, and ports at risk
3. BLUE CYCLONE	Conventional strikes on forward divisions and LoCs	• Adequate firepower in theater • Need for air superiority
4. SUMMER LIGHTNING	Desert Storm-like campaign against Iran Nuclear attack on NCA	• Establishing air supremacy • Inability to find and attack rear area mobile targets (e.g., dispersed WMD TELS)

NOTE: TEL = Transporter-erector-launcher.
LoC = Lines of communication.

Figure 15—The Iranian Scenario: Military Options Summary

Observations on the STRAT-Y Exercise

Observation #1: The participants seemed virtually unanimous in judging the exercise as useful in focusing attention on an emerging and critical set of new defense challenges. The scenario proved to be plausible, engaging, and frightening. Within the individual groups working the scenario and in the larger single group setting, a rich spectrum of issues emerged in a plausible and timely fashion. The resultant group dynamics and discussions were interesting and thought provoking.

Observation #2: The participants were *not unanimous* in their views on the best military options to pursue in the scenario's two crisis steps. In step one, Group 1 (although they were split), leaned away from recommending IRON HAMMER, the preemption option. Group 2 was in favor of preemption, but a minority felt more preparation was required first (possibly in part an excuse to buy time) and

that the President should be told in no uncertain terms that if we start the war with a preemptive strike, it was tantamount to a commitment to invade and occupy Iran. Both groups approved the three-phase GREEN HORNET conventional force projection plan, albeit with various views on the wisdom and political feasibility of exposing large numbers of troops to the WMD threats. "Acceptable" levels of nuclear exposure, the pros and cons of "tripwire" deployments (mostly cons), and nuclear deterrence principles (including extended deterrence) were all debated. In the end, participants were uncomfortable with our political-military situation as presented in the scenario. It was generally agreed, however, that some force projection response akin to GREEN HORNET was necessary. There was great uneasiness, however, about how well the United States could control the course of events in such a crisis.

Observation #3: The threat of nuclear weapons was the critical factor distinguishing this scenario from that of Desert Shield/Desert Storm. Although there were a few participants who were reluctant to increase the level of U.S. military involvement because of the nuclear threat (usually senior military), the majority seemed to fall into two groups:

1. The "damn the torpedoes, full speed ahead" people who would project forces after issuing stern warnings to the Iranians that any WMD use would be dealt with severely. The exact nature of the severe response was debated, ranging from nuclear annihilation to limited nuclear strikes. They also debated the question of what constituted WMD use (see also below).
2. The people who wanted to take all necessary (but time-consuming) measures to mitigate the effects of the adversary's WMD as their first priority (e.g., by minimizing lucrative targets, deploying TBM and air defenses, and taking selective preemptive attack actions against the NCA, C3I, and WMD forces).

While not everyone was willing to project power under the nuclear gun, the players were nearly unanimous in their presumption, if not their view, that if the Iranians used nuclear weapons (recall the ambiguity in the word "use"), we would and should respond with nuclear weapons. They were, however, split on the issue of U.S. nuclear preemption, particularly if it were the only alternative available and

it involved destroying the Iranian national command authority (NCA). All seemed to agree that the United States does not now have adequate plans for contingencies such as that presented—but that it surely ought to.

Surprisingly, there was little discussion on the long-term implications of our actions in this conflict on future conflicts and, most particularly, on counterproliferation in the future—although the subject was mentioned in passing. The players basically became involved in the exercise and narrowed their focus to the immediate problems before them.

Observation #4: For the most part, the participants approached this scenario like "Desert Shield/Desert Storm with nukes." There were no military options proposed that differed much from the operations considered in the game scenario. Participants' uneasiness with the situation might have led to suggestions for more innovative campaign concepts in the future; however, because of time constraints this did not happen at the USSTRATCOM game.

Observation #5: The exercise would have to be judged a qualified success from the perspective of achieving rough consensus on specific new and promising counterproliferation systems and operations concepts and associated enabling R&D initiatives. The qualification may be attributed in part to the lack of adequate time to consider the concepts presented in the tool box so that new ideas could emerge and be critically debated. Although the exemplary ideas suggested to stimulate the participants and the others in the discussions seemed to many to be potentially valuable, a rough prioritization became evident in the two groups. Group 1's priorities were to (1) reduce our vulnerabilities, (2) improve targeting, and, (3) improve weapons. Group 2 focused on (1) continuous surveillance (improved targeting), (2) improved nuclear weapons (e.g., earth-penetrating weapons [EPWs]), and (3) deep penetration long-range platforms (to deliver sensors and weapons). In addition, a number of other ideas were discussed. Next to nothing was ruled out.

Observation #6: The R&D and acquisition communities have the support of military users to investigate a wide range of possible approaches to mitigate the problems exposed in this game. The communities must begin to refine these ideas, suggest priorities, identify

long-term force mix implications, and iterate with the users. The game format will continue to be useful as we broaden our thinking on these challenging policy, operational, technical, and systems issues.

Observation #7: The "ghost at the table" for all of the discussions and deliberations was intelligence or, perhaps better stated, "the intelligence community." It is increasingly recognized that close coordination—at an unprecedented level of detail and timeliness—between the intelligence community and the users will be a key factor in the comprehensive systems approach to the counterproliferation problem that is obviously needed. Achieving the level of integration that will be required was reviewed as a serious inter-institutional problem.

Technology Initiatives with Promise

If the United States were to adopt a phased campaign approach to the nuclear MRC problem, a number of the more promising technology initiatives cited above could be employed in a fashion akin to that summarized in the notional force employment scenario of Figure 16.

Chapter Three describes the bottom-up perspective taken to explore possible technological opportunities to support future demands in the residual deterrence mission and those that are likely to emerge in the prosecution of counterproliferation campaigns such as that employed in the STRAT-Y exercise.

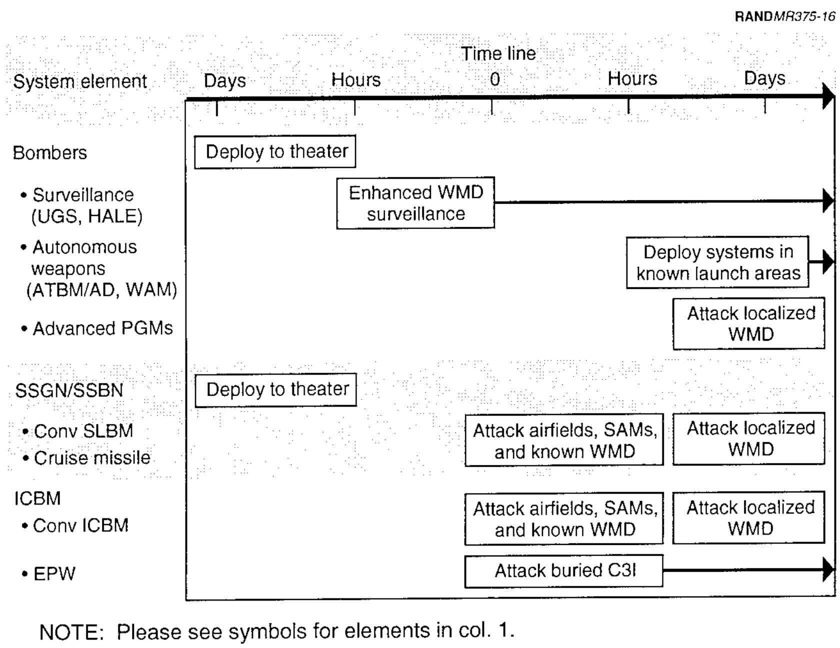


Figure 16—IRON HAMMER II: A Notional MRC Architectural Mix and Force Employment Scenario

Chapter Three

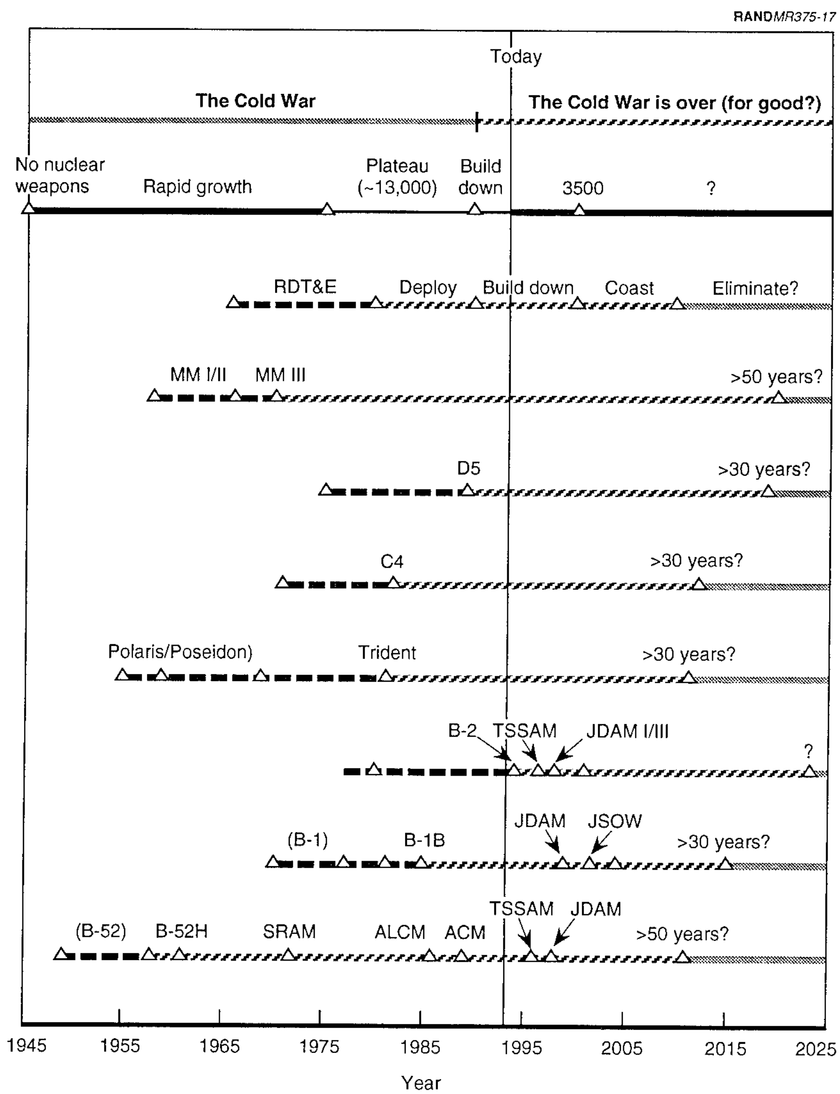
TECHNOLOGICAL OPPORTUNITIES: A BOTTOM-UP PERSPECTIVE

This chapter takes a bottom-up approach (refer to Figure 1) to identify new systems, operational concepts, and supporting technologies to meet the strategic needs identified in the previous chapter. We first address the evolving strategic nuclear deterrence mission and then turn to the new and demanding missions associated with the challenges of power projection against future regional adversaries armed with weapons of mass destruction—emphasizing the potential contribution of the traditional long-range strategic delivery vehicles that are at the center of this study effort.

STRATEGIC NUCLEAR DETERRENCE FORCES: PAST AND PRESENT

It is instructive to look at the history of the Cold War from a systems perspective to highlight trends useful in our assessment. Figure 17 shows event time lines from the dawn of the nuclear age out through this study's 2025 end point. As the top line shows, the world is now a couple of years into the post–Cold War period. Facing an uncertain future, the United States is hopeful that there will be no return to the Cold War arms race that is graphically illustrated on the lower lines of the figure.

The United States reached a plateau of about 13,000 strategic nuclear weapons in the 1980s. Over the next decade under START I and II, this strategic nuclear arsenal will be reduced to some 3500 weapons. While this major reduction effort is under way, the United States needs to think carefully about what kind of critical capabilities need to be preserved in the light of both replacement demands as



NOTE: JDAM = Joint direct attack munition.
JSOW = Joint stand-off weapon.
ACM = Advanced cruise missile.
TSSAM = Tri-service stand-off attack missile.
SRAM = Short-range attack missile.

Figure 17—Strategic Past (and Futures?)

systems wear out and the prospective need to rebuild force levels in the face of a resurgent Russia that could abandon START and dramatically increase strategic nuclear force levels.

The third line from the top in Figure 17 shows a typical development, acquisition, and deployment time line for a strategic nuclear system (Peacekeeper) fielded during the last two decades of the Cold War. From the time a requirement was validated and a system concept developed in this period, it typically took 10–15 years to reach a limited initial operational capability (IOC), with another 5–10 years to reach full operational capability (FOC). Assuming 15–20 years of service, the "cradle-to-grave" life of a typical Cold War strategic system would nominally span three to four decades (or possibly more—consider the B-52).

Notice that in the 1960s and 1970s there were several systems in R&D at any one time. The most recently deployed of these systems will typically reach the end of their service lives (with life extension investments) between 2010 and 2020. Counting back 20 years (average research, development, test, and evaluation [RDT&E] to FOC time), if there are to be replacements for these aging systems, they should enter the RDT&E stage sometime between now and the end of the century. Under the likely assumption that the United States will need to maintain strategic nuclear deterrent forces for the foreseeable future, the process of defining the desired character and composition of this post–2015 force should begin soon, or we may find ourselves in 10–20 years operating increasingly expensive, obsolete, unreliable (and possibly dangerous) forces that may not be able to fully meet the then prevailing residual deterrence requirements.

By 2003, the only ICBM system we will have operational will be a down-loaded (single RV) MM-III. Peacekeeper will be eliminated under START II, as will MM-II (already dealerted). By 2015, these MM-III missiles will be about 50 years old.

With respect to SLBMs, the D-5 procurement is still under way. There remains, however, an unresolved issue of how extensive the C-4 backfit should be. If 30 years is used as the service life of the Trident boats and missiles, by 2015 the Trident force will be nearing retirement as well.

The newest bomber system, the B-2, will still be relatively young in 2015, but will reach age 30 around 2025. However, the B-2's role as a nuclear system is being downplayed, with greater emphasis on its conventional capabilities. Given this fact and the current planned buy of only 20 aircraft, the B-2 has limited (a few hundred weapons) strategic nuclear potential, although circa 2015 this could represent a large fraction of the effective bomber force. The B-52s may still be in the force in 2025 (the Air Force and Boeing believe that the airframe can last until 2040), and the B-1Bs, dedicated to conventional missions under START II, will be reaching age 30 by 2015. No new bombers are under development but, as Figure 17 shows, there are programs to develop nonnuclear air-delivered weapons such as TSSAM, JDAM, and joint stand-off weapon (JSOW).

The following additional perspectives on nuclear forces are also germane:

- The SSBN fleet is not likely to be threatened while at sea in the foreseeable future.
- Interest in improving the prelaunch survivability of the remaining ICBM force (headed toward 500 single-RV MM-III missiles) will likely continue to be small.
- The bomber force, while potentially vulnerable when not on alert, should be able to obtain adequate strategic warning to place it on alert. In addition, near-term threats to the alert force's penetration are not likely to deny the bomber force an independent deterrent threat (although the cancellation of SRAM-II and problems with SRAM may leave us without a stand-off capability other than ALCM and ACM—which some analysts claim might have penetration problems against heavily defended target islands).
- No Russian ABM system is likely to emerge that will seriously threaten the penetration capability of the U.S. ICBMs or SLBMs.

If prompt survivability or penetrativity are not cause for concern with respect to the traditional strategic nuclear deterrence mission, what is? One is survivability under "unusual" circumstances. Consider the following:

- *Failure of strategic warning.* It is important that the entire force not be postured to make it susceptible to loss of strategic warning. Continuing to maintain a number of SSBNs at sea on a day-to-day basis should ensure sufficient capability even in the unlikely event of loss of strategic warning.
- *Enduring survivability.* Limited use of nuclear weapons against U.S. forces might place in doubt the ability of the United States to preserve its nuclear capability for an indefinite period of time.
- *Unconventional threats.* These might arise from paramilitary forces, terrorist attacks, or even electronic warfare threats against computer systems and command and control assets.

STRATEGIC NUCLEAR FORCES AT THE MARGIN

The review of technologies and concepts did not raise any significant new technological opportunities, but it did identify some older system concepts that might be worth revisiting in the new strategic environment.

ICBMs

The current ICBM program is focused on life extension and operational cost reductions for the silo-based Minuteman-III force of 500 missiles. Other than these ongoing initiatives, no ideas for further investment in the silo-based forces were identified in our review.

A common belief in the late stages of the Cold War was that silo-based nuclear-armed ICBMs were inherently at a dead end. This flowed from concern that silo-based ICBMs were increasingly vulnerable to accurate MIRV (multiple independent reentry vehicles) attack and were, therefore, labeled "vulnerable and destablizing weapons." With substantial progress in downsizing the nuclear counterforce threat with the START II agreement to "de-MIRV" the U.S. and Russian ICBM forces, the long-term viability of silo-based ICBMs is enhanced. Further, a force of several hundred single-RV silo-based ICBMs could act as an assured retaliation force for both the United States and Russia against strategic threats other than each other. (Such a force would not be vulnerable to an SOF-type [special operations forces] disabling or disarming attack, in contrast to the

vulnerabilities of a small number of long-range bomber and SSBN bases.) For the foreseeable future, only the United States and Russia will retain or develop a high-performance nuclear counterforce threat to several hundred silos. The only way a threat might emerge is if the Peoples Republic of China (PRC) presses ahead with the deployment of a new generation of highly accurate MIRVed ICBMs, an unlikely prospect for at least the first decade of the 21st century.

The technology exists to develop and field more survivable ICBM systems such as the land-mobile Midgetman program, but the political/military requirements are not compelling, popular support does not exist, and political forces are more likely to eliminate ICBMs altogether than to invest in a new system, given budgetary pressures and the end of the Cold War. There will be an "industrial base" maintenance argument (e.g., specialized nuclear-radiation-hardened parts, reentry vehicles, nuclear warheads) in support of investing in Minuteman life extension. On the other hand, the successful development of a commercial small space launch vehicle such as the *Taurus* should provide a ready mobilization for any follow-on to Minuteman III as a low-cost silo or mobile ICBM sometime in the first decade of the 21st century.

SLBMs/SSBNs

Under START II, SLBM warheads will likely account for about half of the total of 3500 warheads in the U.S. strategic nuclear arsenal. (We assume that the START II force will consist of up to 18 boats, each carrying 24 missiles downloaded to four RVs each, for a total of 1728 weapons.) While we have no reason to believe that serious threats to SSBNs at sea will emerge in the foreseeable future, U.S. dependence on the survivability of relatively few platforms at sea (< 12) suggests that this assessment needs continuing scrutiny.

There are several modernization and START II build-down issues yet to be resolved, beyond the number of Trident boats in the base force and the extent of the Trident II D-5 SLBM backfit for Trident I C-4 missiles cited above.[1]

[1]The DoD nuclear posture review (NPR) has, since this work was completed, capped the SSBN fleet at 14 Trident boats, all equipped with D-5 missiles.

First, the downloaded SLBMs will provide a reconstitution base that should allow the United States to respond to unexpected adverse threat changes (in particular a resurgent and hostile Russia). Obvious candidates for investing against this contingency are storage and upkeep of surplus RV and bus interface hardware, investments in missile-handling equipment consistent with a surge, redeployment, and development of procedures and systems to monitor and respond to threat changes.

With the collapse of the Soviet Union, the open ocean antisubmarine warfare (ASW) threat to the small but modern Trident SSBN forces has all but disappeared. One of the more important strategic modernization issues is whether the Trident fleet, which represents a large capital investment, should be modified to carry out a wide range of post–Cold War strategic missions including the deployment of nonnuclear armed SLBMs and cruise missiles. In essence, the Trident fleet could be treated as undersea dreadnoughts with a multipurpose mission that included the launching of nonnuclear deep strike weapons in support of a regional-strategic military campaign. In such a context one of the issues to be resolved would be whether all Tridents should have a mixed battery of nuclear and nonnuclear weapons or whether a portion of the fleet should be withheld in its traditional and pure nuclear role as an assured retaliation force. With the radical decline in the open ocean ASW threat, it will be possible to consider SSBN operations with far greater connectivity to the theater CINCs and NCA including the regular use of high-bandwidth communications links that exploit the investment in extremely high frequency (EHF) satellite technologies, such as MILSTAR and its likely less expensive follow-on. With high-data-rate communications, a number of SSBNs could operate more like large surface warships and provide long-range high-performance fire support to a theater commander based upon near-real-time targeting information.

Bombers

Under START II, bomber weapons will likely account for almost 1300 of the 3500 weapons allowed the United States. Nominally this force

will consist of 20 B-2s and 94 B-52Hs.[2] (The B-1Bs will be dedicated to conventional missions, and in that capacity will not be capable of delivering cruise missiles.) The deployed bomber weapons will likely be advanced cruise missiles (ACMs) and gravity bombs since the short-range attack missile (SRAM) is plagued with nuclear safety problems (and the follow-on SRAM-II program has been canceled).

Because bombers and cruise missiles have multiple missions (both nuclear and conventional), many of the technologies that might be pursued to aid strategic aircraft penetration are the same as would be developed for tactical aircraft. This will help sustain the high level of penetrativity that characterizes current bomber forces. For example, future theater commanders, possibly caught in the opening days of a new regional conflict without in-place assets, will look to the bomber force to provide firepower well before command of the air and suppression of ground defenses can be achieved. These aircraft may well have to go it alone for some period of time (or with at best minimum support), and any significant attrition may well be deemed unacceptable.

It seems likely that strong interest in the development of a new high-payload, long-range aircraft will begin soon. Considerations will include (a) range/payload, (b) observability characteristics, (c) reliance on external means for defense avoidance/suppression, (d) defensive avionics, to include electronic countermeasures (ECM), decoys, and the like, (e) offensive avionics, and (f) the role of onboard stand-off weaponry (e.g., smart submunitions). In essence, questions will revolve around whether a new long-range bomber should be able to penetrate sophisticated air defenses or operate primarily as a large airborne "truck" to carry advanced stand-off munitions.

Defining the desirable characteristics of a follow-on to the ACM and a possible follow-on replacement for the SRAM will be critically dependent upon the nature of any next long-range bomber design. Any follow-on to the ACM and/or advanced stand-off munition (TSSAM) must consider the potential utility of nonnuclear aerial munitions in a wide range of potential conflicts. An important issue is whether one or more of these advanced nonnuclear munitions can be rapidly

[2]The NPR says 66 B-52s.

converted to an advanced nuclear munition in the event the U.S. dual-capable air fleet needed an enhanced nuclear strike capability.

BM/C3I

We have already discussed battle management (BM)/C3I in the context of the SSBN force. In general, the reduction in deployed and alert nuclear forces should be supported by an increase in the BM/C3I capabilities to ensure the survivability and effectiveness of this limited force. Fortunately, "surplus" assets such as decommissioned ICBMs and SLBMs may be useful as satellite launchers for peacetime or even wartime reconstitution of communications and surveillance systems.

A potential problem concerns threats against U.S. C3I facilities. There are a number of potential threats (conventional as well as nuclear, covert as well as overt) against command and control facilities, their intelligence systems, their communication systems, and their information processing centers. While it is difficult to imagine that such attacks would forever foreclose the authorization or execution of nuclear retaliatory attacks, they certainly could delay or slow down such attacks, perhaps seriously reducing the effectiveness of those attacks and, as a consequence, their deterrent potential.

An important strategic issue is how the C3I system is downsized as the overall nuclear force structure is downsized. If poorly thought out, there is the risk that in the name of short-term economies too much of the C3I system will be dismantled, thereby exposing the U.S. nuclear deterrent to a new generation of "unconventional" vulnerabilities. For the same reason that several hundred silo-based ICBMs are inherently resilient to SOF-type attacks, care will have to be taken to ensure that the smaller C3I structure does not become an inviting target to a small but sophisticated disruption, if not "decapitation," attack.

In addition to these survivability considerations, there are also real-time planning issues. Some assumptions follow:

- To borrow an old phrase, "The first casualty of any war is the plan." For a nuclear war, this is probably as it should be. Nuclear war is too important to be left to the uncritical execution

of a rigid plan. It should not be assumed that any set of plans will be suitable to the circumstances that will arise.

- Technology, in the form of computer capacity (speed plus storage), modern human interfaces (to make available to planners and decisionmakers the knowledge locked in the computer), and rapid, high-data-rate communications offer significant opportunities for near-real-time planning, both pre- and post-attack. These capabilities will help eliminate the enduring survival problems discussed above, and will improve both the efficiency of the plan and the subsequent attack's effectiveness.
- For most nuclear wars (and for nuclear deterrence), the possession of a secure capability to execute nuclear options of any type and size strongly reinforces the inherent capabilities residing in the forces themselves. It reinforces the inevitability of an appropriate nuclear response in the minds of the enemy leaders, lessening the prospects that they might misjudge U.S. capabilities.

A possible deterrence "new think" implication might be an increasing emphasis on real-time war planning and a deemphasis or rejection of nuclear systems targeted in peacetime. Although current forces do not have access to near-real-time planning capabilities, their numbers (often characterized by the degree of overkill they can inflict) make planning matters (particularly "efficiency" arguments) moot. As the size of the force decreases, however, planning will assume a greater importance. As a consequence, the Single Integrated Operations Plan (SIOP), as we currently know it, may be becoming obsolete. The new strategic nuclear targeting focus might well emphasize military systems that are either mobile or otherwise considered to be time-critical targets (TCTs).

The SIOP was originally introduced for deconfliction and targeting efficiency. As we downsize our arsenal and back away from nuclear warfighting as it has evolved in the SIOP, deconfliction issues should become less critical. Perhaps most important, however, the SIOP has become unwieldy and a virtual planning nightmare. Given ongoing changes in the threat, a lot more flexibility than the SIOP as traditionally constituted may be able to accommodate is in order. The answer to this change in demand is probably real-time, responsive, deliberate war planning. Given the objective reality that future nuclear options in a regional strategic context will likely be measured in

the tens of designated ground zeros (DGZs) rather than hundreds or thousands, rapid regional nuclear strike planning, including near-real-time targeting, seems technically and financially feasible.

In light of the above arguments, a detailed review of how nuclear planning could be improved is probably in order. Such a review should address the benefits of smaller forces, reductions in MIRVed forces, and reductions in the total number of targets that need to be covered. It should also seek to capture alternative views of nuclear targeting requirements, recognizing that most of the lessons of the past (e.g., some codified in the 1980s) may no longer be of value.

New Strategic Concepts

Beyond the need discussed above to maintain a traditional nuclear deterrent force, might there be a need to develop a new strategic nuclear warfighting force as a replacement for or adjunct to the nonstrategic nuclear forces? Or can strategic delivery systems, many of which may otherwise be destroyed in the START build-down, find cost-effective applications as nonnuclear delivery systems?

Nuclear Applications

The use of nuclear weapons in 1945 against Japan was in part rationalized as saving both Japanese and American lives by ending the war quickly and avoiding a costly invasion of the Japanese mainland. Might future limited nuclear weapons use be as "necessary" as it was in 1945 for similar reasons? Or, as seems more likely, might a decisive but limited nuclear use by the United States be called for in response to first use or aggressive brandishing of WMD by proliferants? The issue of nuclear use against a nonnuclear state has been resolved by the Non-Proliferation Treaty (NPT). But the existence of "virtual" or undeclared nuclear arsenals and the possession or use of other WMD, particularly biological weapons, may pose a serious dilemma for the United States and its allies—and could see the 1945 arguments resurface in a future crisis.

There were a number of good political, military, and practical reasons for the withdrawal of most nonstrategic nuclear forces (NSNF) from ships and overseas bases. We looked at what modifications to

strategic nuclear weapons systems might be necessary if they were to play a role formerly played by NSNF. The larger issues of nuclear doctrine, both strategic and nonstrategic, will be debated in the coming years. Our purpose was to inform that debate vis-à-vis strategic nuclear systems potential.

Enhancements or modifications to our strategic nuclear weapons and delivery systems would almost surely be required before they could be considered for limited use in a future MRC fought under the WMD gun. We've identified several issues for each leg of the Triad:

ICBMs: There has never been a successful test launch of an ICBM from an operational silo, primarily for safety reasons. Safety issues, coupled with overflight restrictions, may also preclude consideration of limited nuclear strikes from current operational ICBM silos. Thus, any ICBMs used in a nuclear MRC will presumably have to be moved to a coastal launch site such as the missile test ranges at Cape Canaveral and Vandenberg. Since part of the appeal of ICBMs is the potential to deliver weapons promptly, these "nonstrategic" nuclear-armed ICBMs (say 10–100 single-RV missiles) would presumably have to be redeployed to their coastal launch sites in peacetime (recognizing that this rebasing would require renegotiation of the START treaties).

There would also have to be changes to the missile itself for safety and security. Some sort of command destruct system would have to be incorporated, together with provisions to ensure that the nuclear weapon would not be lost, that no nuclear detonation could occur, and that no nuclear materials would be dispersed if the mission were aborted or otherwise failed.

While the current guidance systems are accurate for the current weapon yields, it may be desirable to augment them for added precision and reliability with a Global Positioning System (GPS) or mid-course/terminal radio update system.

The nuclear weapons themselves also should be changed to permit, for example, dial-a-yield (subkiloton to tens of kilotons) and height-of-burst selection (from exoatmospheric to contact). Specialized weapons may be valuable for enhanced effects and collateral damage control (e.g., EMP or EPWs for contained effects and ground shock coupling).

Finally, responsive mission planning systems are needed, along with timely predictions of weapon effectiveness, collateral damage (prompt and delayed), and assessments of post-attack bomb damage assessment. Targeting might have to take place quickly (in minutes to hours versus days or weeks). Friends and other affected parties (e.g., the Russians, who might be alarmed by ICBM launches) would have to be alerted prelaunch while denying warning to the enemy.

SLBMs: SSBNs may be better suited than ICBMs for a MRC mission from a basing perspective since they can be positioned to minimize overflight issues. As with the ICBMs, special single-RV payloads would need to be fielded, missile mods would need to be built in for safety and security, and BM/C3I enhancements would be required. As noted above, an important issue is whether future SSBNs will deploy with a mixed battery of nuclear and nonnuclear weapons.

From an arms control perspective, SLBMs have the advantage that downloading is acceptable and no rebasing is required. On the other hand, our uploading provisions may be constrained, effectively reducing our at-sea deterrent by three weapons for every weapon we deploy for this nonstrategic mission (assuming we will download to four RVs/SLBM as a result of START II).

Bombers: Using bombers in this role would be feasible, but there are factors that militate against such use. For example, bomber reaction time will be much greater than the reaction time of the ICBMs or SLBMs. In addition, bombers will be deployed in limited numbers and there are already multiple demands (conventional weapons delivery and nuclear deterrence) for their utility. Guaranteeing nuclear safety and security for bombers may also be challenging given the chance (albeit small) that a bomber force attacking in small numbers will be shot out of the skies over enemy territory.

Nonnuclear Applications

Can strategic delivery systems, many of which may otherwise be destroyed in the START build-down, find cost-effective applications as nonnuclear delivery systems?

The use of traditional long-range strategic assets to support regional conventional conflicts is by no means new. B-52 bombers were used

in Vietnam and in Desert Storm. The potential role for bombers as a quick-reaction leading-edge power-projection force to blunt armored invasions of allied territory was a major element in the rationale behind the Air Force's current Bomber Road Map. Bomber-launched smart/brilliant submunitions can threaten mobile systems (e.g., armor) and relocatable systems (e.g., SAMs) independent of range to the target. In addition, emerging technologies would also give long-range ballistic missiles near-zero CEP (circular error probable) accuracy independent of range and would allow them to threaten tactical targets that would be difficult to attack effectively with aircraft or cruise missiles (e.g., time-critical C3 systems or heavily defended sites and airfields).

ICBMs/SLBMs: It is assumed that under START nonnuclear payloads (satellites and weapons) can be deployed in existing silos or SSBN launch tubes, albeit subject to being counted as a nuclear ICBM or SLBM. A similar argument in terms of existing START counting rules would presumably hold for new specialized launchers for nonnuclear ICBMs and SLBMs. Figure 18 summarizes the unique potential that ICBMs may offer.

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- Unique capabilities:
  - Preemptive strikes on fixed targets (e.g., WMD, leadership)
    - Prompt response (hours for mission planning?)
    - Minimum warning (30–40 min flight time)
    - Near-simultaneous arrival (10s to few 100s)
  - Lethality (use kinetic energy?)
  - No forward deployments/risks
  - No losses to defenses or crews at risk
  - Psychological impact ("Death from the Heavens")
- Other:
  - Hedge our nuclear deterrent posture
    - Convert to nuclear (or use as is)
    - Maintain core ICBM/SLBM competencies
  - Why not? Relatively cheap and may be just what we need some day

Figure 18—Nonnuclear ICBM/SLBM Rationale

Conversion of the SSBNs eliminated under START to noncontrolled systems may also be of interest. Submarines might in the future provide a cost-effective way to carry out missions now satisfied by surface combatants as a response to the increasing risks to forward-deployed surface ships posed by shore-based cruise and ballistic missiles, air-delivered weapons, and submarines (particularly quiet diesel-electric boats) in the hands of regional adversaries.

Bombers: Bombers are already scheduled as either dual-role (nuclear and conventional) or single-role (conventional only) weapon systems, and bomber penetration capabilities are likely to continue to be upgraded to ensure their utility in both conventional and nuclear employment roles. Bombers will be outfitted to carry a wide range of conventional armament, eventually including JDAM weapons, all variants of TSSAM, and the usual collection of tactical munition dispensers (TMD). Bombers will also be outfitted with a variety of sensors, augmenting their capability to carry out missions that are not completely preplanned and that require some degree of target location and identification. As a consequence, future bomber forces could have nontrivial conventional attack capabilities against regional strategic adversaries.

THE STRATEGIC INITIATIVES "TOOL BOX"

The study team identified a wide range of technological opportunities to exploit strategic delivery platforms in nonnuclear warfare missions. A small filtered set of representative concepts was provided as a "tool box" of candidate initiatives to the participants in the STRAT-Y planning exercise described above.

The primary filters applied in arriving at these examples were related to the uniqueness of the strategic systems' potential contribution to future MRCs. There were two areas in which this unique potential was most evident:

- Striking time-critical targets deep in enemy territory.
- Responding in a crisis or war before adequate conventional forces can be projected into the theater.

These two dimensions of the problem and the gaps we might fill with new strategic systems concepts are shown in Figures 19 and 20, respectively.

The missions or tasks for strategic systems that can strike deep from long range without time delays for forward deployment include the following:

- Accurate knowledge of location, type, and status of time-critical targets.
- Weapons capable of exploiting targeting information.
- Reduction of vulnerabilities to adversary WMD.

EXEMPLARY COUNTERPROLIFERATION CAMPAIGN CONTEXTS

1. "Pre-/Early Crisis" Preemption

In peacetime or crisis, we may need to augment "normal" intelligence collection capabilities with more intrusive means to achieve the necessary responsiveness and precision to support preemptive strike decisions and execution. For example, fearing that hostilities are imminent, we may want to strike the hostile power's WMD systems (weapons, delivery systems, C3I, and possibly NCA).

There could also be crises in future MRCs in which a preemptive attack on a nuclear-armed adversary might be considered even if there were little if any chance of completely dis(nuclear)arming him and the attacks did not result in large numbers of collateral fatalities. In such a context, there would be a high premium on having a capability to disrupt, disable, or destroy those high-value time-critical targets (e.g., nuclear-armed IRBMs), both fixed and mobile, that an adversary would likely deploy in well-protected sites deep inside his territory—beyond, for example, the likely reach of most theater-based aircraft.

The element of surprise, both strategic and tactical, may be critical but difficult to achieve by existing theater-based aircraft. For example, to minimize warning, weapons may have to arrive nearly simultaneously over a large geographic region, which also may be difficult

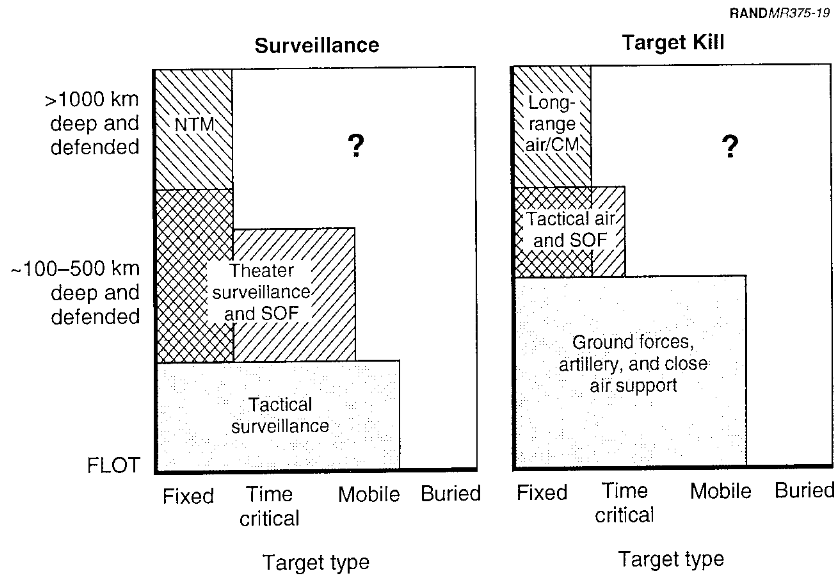

Figure 19—The Depth Dimension: Generalized Current Capabilities

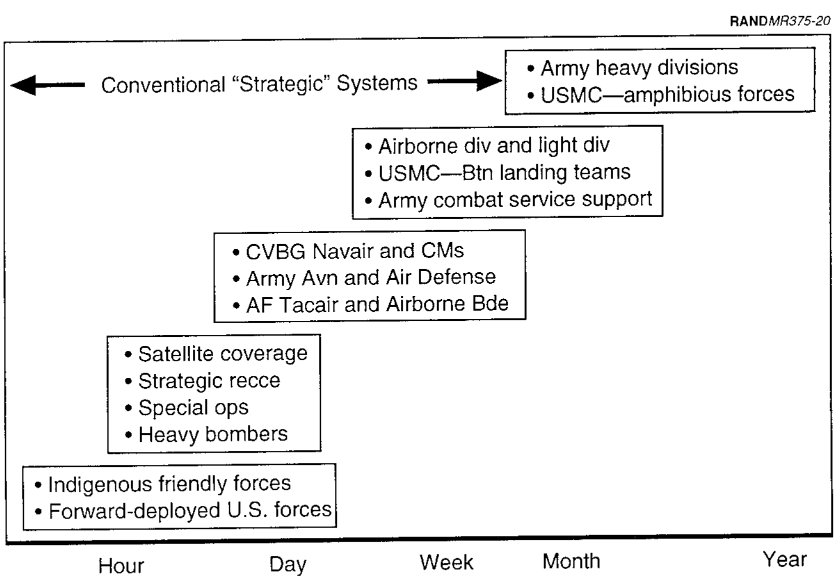

Figure 20—The Response Time Dimension: Generalized Current Capabilities

with theater-based air forces, particularly if some sort of defense rollback is required to minimize losses.

In a future MRC crisis (assuming that there has been an ongoing aggressive intelligence collection and analysis process in peacetime), we should have a good idea of where most of the weapons are deployed day-to-day and what the wartime concept of operations might be. At some point in a developing crisis, the antagonist will almost certainly transition to wartime operational status, dispersing (for example) missile TELs (transporter-erector-launchers) to field sites well away from peacetime garrisons. We would like to have means available to us during the crisis to prevent successful missile launches from these dispersal areas.

2. MRC Power Projection Against a Nuclear-Armed Adversary

The need for target knowledge could be driven by the need to neutralize the threat of WMD against friends and allies in the theater and U.S. forward-deployed forces or planned forced entry points. In such a situation there would be a high premium on locating and monitoring the WMD threat systems to ensure early tactical warning and to support attack operations against the WMD systems.

There could also be MRCs in which the United States and its allies or coalition partners project force into a region in spite of the presence of the adversary's nuclear threat. In such a situation, there would be a high premium on being able to quickly and effectively attack and counterattack his nuclear systems.

In addition, concentrations of forces (air and ground) that might be required to stop or disrupt an invasion of an ally or friendly country may be difficult to field and operate effectively because of the threat of nuclear or other WMD strikes or because of the disparate pace of the threat relative to our forward deployment rate. In such a scenario, long stand-off systems with smart/brilliant munitions may be an effective way to buy time.

During the war, there will be an intensive campaign to neutralize the WMD systems, both through TMD deployment and attack operations. The more layers in our defensive architecture, the fewer WMD weapons that will reach their targets.

Accurate Knowledge of Location, Type, and Status of Time-Critical Targets

It is essential to be able to hold TCTs at risk in peacetime, crisis, and war both for preventive and preemptive strikes and for wartime attrition of enemy forces to resolve conflict early and limit damage. This will be particularly true in dealing with WMD. The critical task is to find such systems.

In the case of fixed installations, the problem has two dimensions: (1) specifying the location precisely for attack systems and (2) identifying the kill requirements, such as timing (e.g., bunker occupied or not), destroy/disable criteria (e.g., collapse the structure or mission kill by cutting communications), and collateral damage constraints. For fixed installations, systems such as national technical means (NTM) and imagery and electronic intelligence (IMINT and ELINT), in particular, are ideally suited for peacetime intelligence needs. Locating the targets for precision strike is greatly aided by the Global Positioning System, although extreme precision strike (CEP < 10 meters) may require adjuncts to GPS such as terminal homing.

Mobile targets such as ballistic missile TELs can, to some extent, be addressed by the same systems. TELs and support systems may reside in known garrisons and may be localized in technical support bases or in the field by NTM, SOF, human intelligence (HUMINT), and battlefield surveillance systems such as ASARS II and JSTARS. But there is another dimension to the mobile TCT problem: the mobile assets can "get lost" by moving out of sensor coverage or into unresolvable clutter backgrounds or, in the limit, dispersing into "deep hide." The motion necessary, however, involves exposure that allows moving target indicators (MTI) and change detection techniques. The moving TELs must be in the sensor's field-of-view (FoV) (e.g., within 200–300 km of JSTARS), and the system (sensors, processors, and fusion) must be able to discriminate the TEL from similar moving vehicles—a difficult problem that will require multispectral systems, possibly on a variety of platforms that can operate in deep, defended enemy territory.

System/Technology Concepts. The systems in this part of the tool box deal with long-range delivery of sensors to augment normal peacetime, crisis, and wartime capabilities. These capabilities will be

integrated into the overall intelligence and surveillance architecture to tell the deployable sensors where to look and what to look for. The sensor systems to be delivered by strategic platforms range from surged "light sats" for multispectral IMINT, to very-high-altitude stealthy unmanned air vehicles (UAVs) for IMINT, ELINT, and MTI, to unattended ground sensors (UGS) with seismic/acoustic, magnetic, radiation, IR, and visual sensors to detect and classify targets moving on road networks or in known deployment areas.

The integration of sensors, platforms, and stand-off delivery systems may enable responsive deployments to find and target TCTs in any future MRC, particularly if those TCTs are deep in the rear and present an immediate threat (e.g., mobile, nuclear-armed IRBMs). These sensors may also provide critical bomb damage assessment (BDA) capabilities. The strategic delivery systems, shown in the illustrations below as bombers and cruise missiles, may be available even if the forward-deployed infrastructure is limited because of deployment delays or the need to minimize the exposure of U.S. personnel until long-range WMD threats can be neutralized through attack operations or active theater missile defenses (TMD). (Target kill and TMD will be discussed separately.)

Figure 21 depicts the delivery of sensor-carrying high-altitude, long-endurance (HALE) UAVs from long stand-off distances by bombers—in this case a B-52H. The intent is to get the UAVs on station quickly while minimizing the risks to U.S. personnel. Unlike ground- or sea-launched UAVs, which might require substantially longer time to deploy, the bomber-delivered systems could be on station within hours of the perceived need. Sensor packages can include imaging sensors in the visible, IR, and radar synthetic aperture (SAR) regimes as well as MTI radars to support surveillance, targeting, and BDA missions. A HALE UAV could also serve as a platform for laser designation of targets in the surveillance area for direct support of deep-strike missions.

In addition to its high-altitude operating regime, low observables techniques can further enhance on-station platform survivability. HALE UAVs delivered to the proximity of their assigned patrol area at or near operational altitudes (e.g., by a bomber or cargo aircraft or ballistic missile) make possible efficient long-endurance designs.

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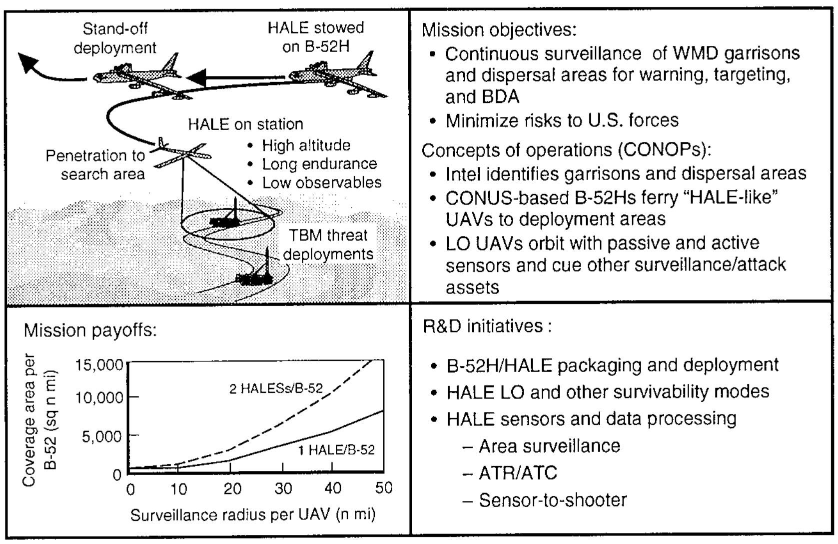

NOTE: LO = low observables.
ATR/ATC = automatic target recognition/classification.

Figure 21—B-52H-Deployed High-Altitude Long-Endurance (HALE) for Continuous Surveillance of WMD Operations

Figure 22 depicts a similarly responsive delivery concept for UGSs. UGSs enable continuous surveillance of wide areas in remote regions over long periods of time in several sensor regimes and spectral bands. They could be dispensed from air-, submarine-, or surface-ship-launched cruise missiles. The sensors would then report back via dedicated light satellites or UAVs such as were shown previously. Small and lightweight, large numbers of UGSs can be sowed over wide areas to make possible high-confidence surveillance of critical areas, such as WMD deployment, dispersal, or storage sites. The UGS unit is designed to be stealthy in the sense that most of its (already rather small) volume is buried, and only those elements that must be above ground are above ground (e.g., communications antennas and IR sensor elements). Effective sensor ranges vary from sensor type to sensor type, but for most a relatively modest UGS payload is adequate to monitor a sizable area. UGS array networks

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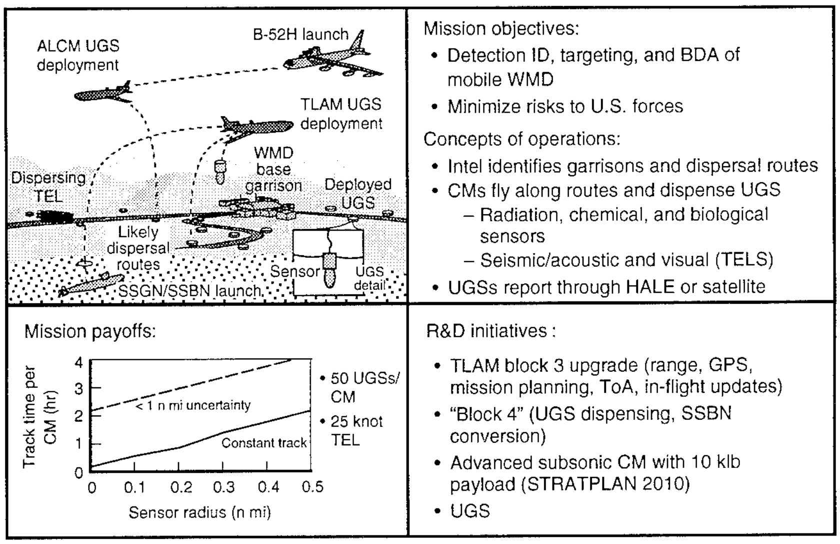


NOTE: TLAM = Tomahawk land attack missile.

Figure 22—Cruise Missile UGS Deployments to Detect Mobile WMD Systems

can be deployed to track, localize, and target enemy assets to support deep strike missions and to support post-strike BDA.

R&D Initiatives Enabling. The R&D initiatives fall into three areas:

- Sensors and processing
- Sensor platforms/packaging
- Delivery systems integration

Various sensor suites for UAVs are under development at ARPA and elsewhere. For the concepts in this tool box, it will be important to review these sensor development activities to ensure that all unique mission-specific signatures are being exploited and that performance goals are appropriate (e.g., low probability of intercept [LPI], sweep rate, Pd/Pfa). Since these sensors will be on unmanned platforms and secure wide-band communications will be difficult, im-

proved automatic target recognition or classification (ATR/ATC) will be particularly important. The more focused the target search, the more successful these efforts might be. For example, the UGS seismic/acoustic sensors could be trained against real TELs under various operational conditions to allow them to discriminate between a specific type of TEL and similar vehicles such as large trucks.

The sensor platforms, either a UAV or ground implant, are also in various stages of development. The issue is compatibility with these operational concepts (sensor suites, delivery means, and on-station performance [e.g., endurance, stealth]).

Finally, some ongoing initiatives may need to be revectored somewhat and augmented to accommodate these long-range delivery concepts. For the cruise-missile-deployed UGS, for example, the TLAM Block 3 upgrades will be important enhancements (range, GPS, mission planning time-of-arrival [ToA], in-flight updates). There may need to be initiatives in a new "Block 4" to support UGS dispensing and possible cruise missile deployments in dedicated platforms such as converted SSBNs. In the far term, much larger payload (e.g., 10 klb) cruise missiles may need to be developed for this mission. In the bomber-deployed HALE concept, the number and size of the UAVs will need to be optimized within the physical and mission constraints.

Weapons Capable of Exploiting Target Information

Given the type of target intelligence that might be available from the systems described above, the issue becomes how to deliver the appropriate weapons within time lines determined by the operating practices of the threat and perishability of the targeting data—subject to a range of political and military constraints on collateral damage and risks to U.S. forces, friends, and allies.

The force applications we are most concerned with here are those for which current and projected forces are, for three reasons, least capable of performing:

1. Lack of forward bases or adequate in-place forces

- Generation and deployment time lines may be long relative to the threat time lines
- Risks to forward bases, ships, and ports of debarkation posed by enemy WMD may further slow the process of coalition building and deployment to the threat region

2. Limited reach into deep, highly defended areas where certain classes of WMD (e.g., mobile nuclear-armed IRBMs) will likely be deployed
   - Time-consuming "boot-strap" process
     - Deploy to and secure (e.g., via TMD) bases in the theater
     - Establish air superiority/supremacy via suppression of enemy air defenses (SEAD) and offensive and defensive counter-air (OCA/DCA) missions
   - Range/payload limitations of tactical aircraft
3. Ineffective weapons delivery and lethality
   - Poor target acquisition by attack aircraft
     - Large search areas resulting from target movement and long aircraft time-of-flight
     - Operational constraints limiting attack aircraft target acquisition and discrimination sensors
   - 15–20 kft altitude and stand-off to defeat antiaircraft artillery (AAA) and shoulder-fired IR SAMs
   - Weapon delivery accuracy
     - Weather limitations (laser-guided bombs [LGBs])
     - Target location errors (inertial navigation system [INS]/GPS systems [JDAM/JSOW])
   - Lethality
     - Deeply buried (e.g., 100 ft) bunkers
     - Caves and tunnels

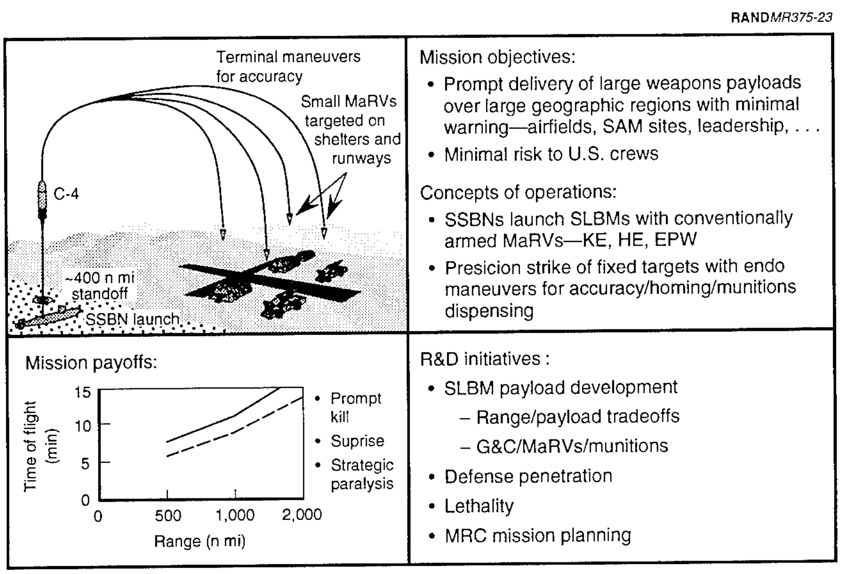
There are, within various Service and DoD laboratories and research agencies such as DNA and ARPA, programs under way to address many of these issues, particularly those associated with all-weather, stand-off, and direct attack "precision strike" weapons and stealthy delivery systems. The areas we explored address capabilities not in the mainstream of this research (but that can obviously benefit from it):

1. Long stand-off/short time-of-flight conventional weapons delivery systems
2. "Usable" nuclear weapons: (a) very low yield (e.g., < 1 kt) earth-penetrating weapons (EPWs) to hold buried targets at risk, (b) and area effects electromagnetic pulse (EMP) weapons—both of which can be employed in such a way as to limit collateral damage, but which have significant political limitations and effects.

System/Technology Concepts. The tool-box concepts involve delivery of a variety of conventional weapons by long-range ballistic missiles, "usable" nuclear EPWs delivered by SL/ICBMs, and bomber-delivered munitions to blunt armored invasions.

Figures 23 and 24 show the ballistic missile delivery concepts. The SLBM concepts include (i) downloading the nuclear RVs on surplus C-4 missiles (about 400 will be available) and uploading kinetic energy rods for shotgun-like area attacks (e.g., on aircraft or vehicles in the open); (ii) small MaRVs for accurate attack on arrays of point targets (e.g., aircraft shelters); or (iii) glide vehicles with dispensers of smart munitions. In the extreme, everything above the first stage could be replaced with conventional weapons, reducing the range but increasing the payload to bomber-like levels.

The SLBM concepts have attractive range/payload and launch location flexibility, but there are obvious arms control issues that would have to be addressed. The Navy's Strategic Systems Project Office (SSPO) has been exploring these issues and suggests that a workable solution might be to deploy these conventional payloads on a few of the older Trident boats within a total START-II limitation of an 18-boat fleet. (This is *not* a Navy position but rather an exploratory investigation.) The resulting day-day (normal alert posture in peacetime) nuclear potential would be significantly below the START-II allowed level, but these conventional forces could be used to recon-



NOTE: KE = Kinetic energy.
HE = High explosive.
G+C = Guidance and control.

Figure 23—Nonnuclear-Armed C-4 SLBMs for Precision Strike

stitute the nuclear force if required by a resurgent Russian (or Chinese) threat.

The ICBM concepts, which typically involve high-performance MaRVs (HPMaRVs), have been studied at the Air Force's Phillips Laboratory. Again, the idea would be to use surplus missiles (MM-II/III and, possibly, Peacekeeper) with conventional payloads from coastal launch sites (e.g., the eastern and western test ranges). Rebasing these assets is a START requirement and would likely be required in any event for launch safety considerations. The HP MaRVs provide range extension and maneuver footprints to ensure that all missile debris can impact in the ocean with worldwide target coverage. The HPMaRV can be used as a hunter/killer against TCTs (e.g., mobile missile TELs or NCA elements) or as a killer of fixed targets where extremely high accuracy is required (e.g., when attacking deeply buried structures).

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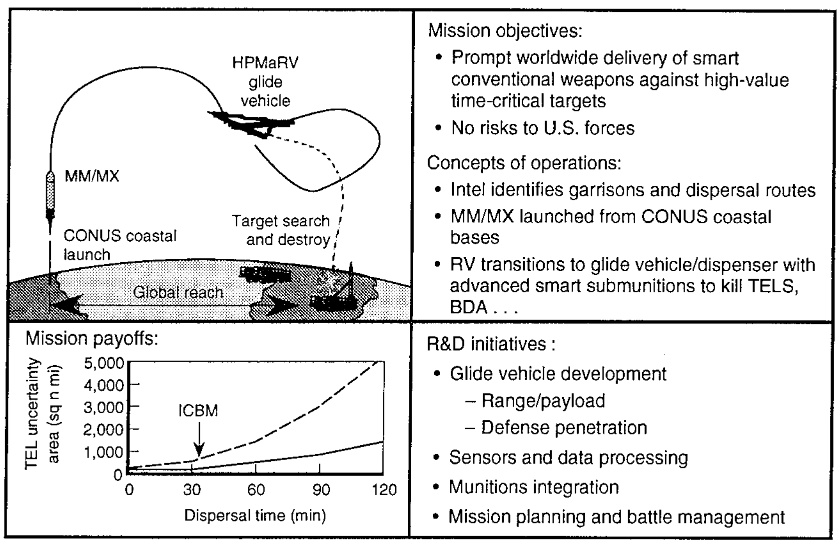

Figure 24—MM/MX-Delivered Boost-Glide Vehicle for Strikes on Time-Critical Targets (TCTs)

Figure 25 shows the delivery of a MaRV EPW for attacks on time-critical buried targets such as command bunkers. If EPW depths on the order of 50–100 feet can be achieved, which seems possible based on tests conducted by DNA and the nuclear laboratories, then nuclear yields less than 1 kt should result in no significant collateral damage in the target area (blast, radiation, and fallout). Whether this would be a "usable" nuclear weapon is debatable, but in the near term, it may be the only way to hold many of these targets at risk. Nuclear EPWs provide the highest confidence "hard kill" against deeply buried structures. In the longer term, research at DNA and elsewhere may allow us to replace the nuclear weapon with other unconventional, but nonnuclear, weapons. Obtaining confident BDA for deeply buried targets will always be a challenge, particularly for functional kills.

Enabling R&D Initiatives. Ballistic missile conventional weapons have been studied for some time, but there is no focused effort to de-

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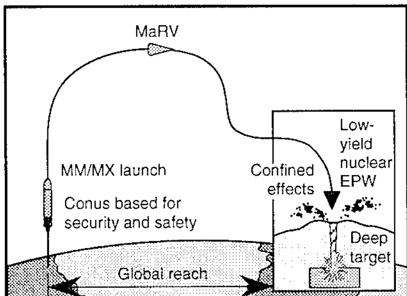

Mission objectives:

- Prompt destruction of deeply buried targets worldwide with minimal collateral damage
- Minimize risks to U.S. forces

Concepts of operations:

- MM/MX launch of small yield (<<1 kt) nuclear or enhanced conventional EPW in MaRV for accuracy/vertical impact/velocity control
- Fuze on the run at desired depth
  - 50–100 ft (scaled to 1 kt)
  - Contained effects with no wide area fallout

Mission payoffs: Nukes may be the "only" option

Lethality	EPW		Nonnuclear surface
	Nonnuclear	Nuclear	
Facility kill	?	X	No
Functional kill			
• C3	?	X	?
• Support	?	X	?
• Other?	?	X	?

R&D initiatives :

- Low-yield nuclear weapons development or enhanced nonnuclear weapons (e.g., fuel-air explosive (FAE), microwave)
- EPW design and ICBM integration
- Targeting
  - Intelligence
  - BDA
- Lethality

Figure 25—MM/MX-Delivered Low-Yield Nuclear or Enhanced Lethality Nonnuclear EPW to Hold Buried Targets at Risk

velop and field the kinds of capabilities alluded to above. Areas in which continuing or expanded research may be called for include:

- Target acquisition: Very low observable covertly deployable unattended ground sensors, high-altitude long-endurance aircraft, satellite-based radars and multispectral sensors, and covert tagging for continuous surveillance in the light of strategic warning.
- Payload development: Maneuvering reentry vehicles capable of in-flight update on target location, conventional and nuclear earth-penetrating weapons, EMP weapons for attack of dispersing forces and C3I nodes.
- Mission planning: Systematic assessment of time lines and coordination with regional forces for preemptive attack and immediate follow-on military action.

The Air Force's "Bomber Road Map" addressed missions such as we described above, but there are still R&D and acquisition issues associated with the munitions (ALCM-C, JDAM, JSOW, JDAM-II, JSOW-II, TSSAM, etc.), bomber integration, and base force.

Reduction of Our Vulnerabilities to WMD

None of the capabilities suggested in this tool box will allow us to, in effect, reduce the possible future nuclear MRC case to the past non-nuclear case that worked so well in Desert Shield/Storm. We cannot be assured that offensive actions against WMD will succeed 100 percent, or that active defenses will negate 100 percent of the assets we cannot destroy before launch. Therefore, we must look for additional ways to further reduce our vulnerability to the WMD threats so that we can maintain some military effectiveness at acceptable risk levels.

The long-range delivery systems for sensors and weapons we discussed above could be one part of the solution—they might reduce our risks by letting us stay out of harm's way to the maximum extent possible, at least until we have negated some significant part of the WMD threat. This suggests that future power projection concepts of operation might have to be significantly changed, perhaps incorporating long-range systems as a partial enabling capability.

Second, passive defensive measures such as hardening (particularly against wide-area nuclear effects such as EMP), dispersal, camouflage, cover and deception (CCD) will be necessary, since, if nuclear weapons are used, some leakage must be expected.

Finally, the current Ballistic Missile Defense Organization (BMDO) thrust in TMD is toward terminal defense systems such as Patriot PAC III, THAAD, and Aegis ships. Many of these systems can be forward deployed by the United States or sold to friends and allies in the region.

In the context of this study, all of these capabilities will be critical. The area we will explore a bit further in the last part of the tool box, however, is the use of long-range delivery systems to augment ballistic missile defenses.

System/Technology Concepts. There are several concepts that have been proposed to augment TMD architectures being developed by BMDO. Examples include boost-phase kill systems such as an airborne laser system (ABL) and kinetic kill with air-to-air rockets launched from manned aircraft such as the F-15E or UAVs. The area explored here is a form of boost-phase theater ballistic missile kill by interceptor mines emplaced by stealth aircraft such as the B-2 shown in Figure 26. The boost-phase kill mines in this concept are under study by various organizations. One version is a cylinder about 1 ft in diameter by 6 ft in length with an auger on the end for self-burial to hide the two-stage interceptor missile and its supporting launch detection sensors and control devices.

The stealthy delivery system might permit us to emplace these mines covertly prewar, which would give us a pin-down capability (if they launch, they are killed). Similarly, once hostilities have begun, the mines could be emplaced and renewed as they are used or are disabled by the enemy. The mine's relatively small size and light weight

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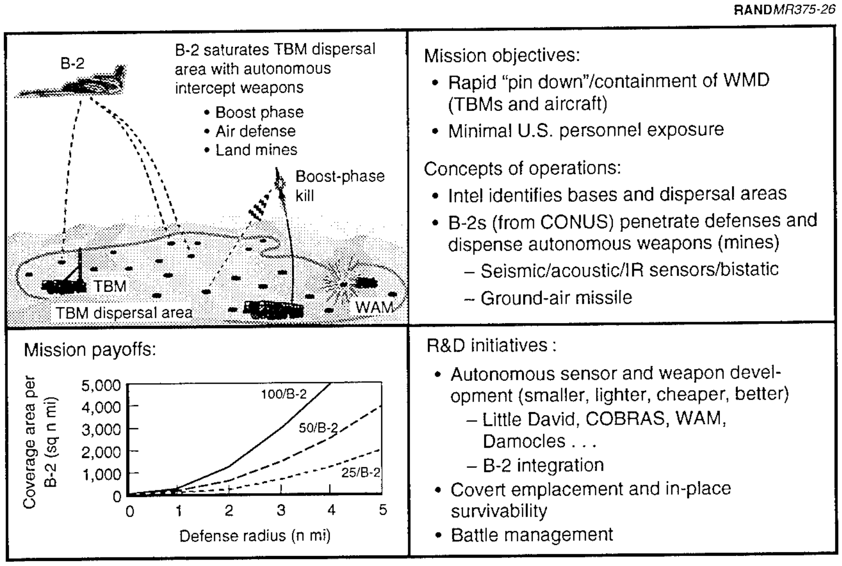

Figure 26—B-2-Delivered Autonomous Weapons (Smart Mines) for Prelaunch and Boost-Phase Missile Kill

makes it ideal for its deployment in large numbers over wide areas by penetrating bombers or ballistic missiles. It has a surprisingly large engagement footprint potential given its small size and low weight.

Also shown in Figure 26 are wide-area mines (WAM) that could be emplaced in TBM deployment areas to kill moving TELs both before and after launch. WAM is a class of smart mines that autonomously sense, identify, and attack high-value targets such as armored vehicles, missile TELs, and the like. The baseline WAM uses seismic and acoustic sensors effective at ranges of 500 m and fires an explosively formed projectile at the target out to ranges of about 100 m. WAM also has some capability against low-flying helicopters and, perhaps, other aircraft (e.g., cruise missiles). Its small size, light weight, and high lethality make it an ideal candidate for aircraft or missile deployment over wide areas against missile TELs or other WMD support systems in dispersal areas deep within a proliferant nation's territory.

Enabling R&D Initiatives. Smart defenses are currently only conceptual. They do not violate any known laws of physics, but there is much to be done and demonstrated in R&D initiatives. In particular, the initiatives should include:

- Autonomous sensors and weapons (smaller/lighter, cheaper, more robust)
- Covert emplacement (integration with delivery platforms such as the B-2)
- Command and control issues.

Chapter Four

CONVERGENCE ON INITIATIVES AND NEXT STEPS

This chapter assesses from a strategy and policy perspective the problem of converging on technological initiatives in the light of the relatively undeveloped nature of this subject. It then indicates possible directions for future work in this important and rapidly evolving national security arena.

INITIATIVES: TOP-DOWN MEETS BOTTOM-UP

This study has identified a set of preliminary candidate initiatives based on a synthesis of top-down and bottom-up analyses. These initiatives can potentially fill identifiable gaps between high-risk/high-payoff activities such as ARPA's Warbreaker and the unaddressed opportunities within the Service System Project Offices (SPOs) and operational commands to make what the military has work better against emerging threats. Beyond the necessary understanding of concept specifics and "the technical meat," what is needed is a general community understanding and appreciation of (and consensus on) the strategy and policy problems—and the derivative military problems—that are emerging because of the proliferation of WMD. Only with this understanding can the needed decisionmaking processes and a coherent set of new post–Cold War strategies and supporting policies be achieved.

Our goal has been to lay out the basis for a supportable R&D program for near-term implementation (budget action) to meet long-term needs. In this context Strategic and Space Systems (S&SS) needs to suggest strategic systems or Advanced Concept Technology Demonstration (ACTD) initiatives that are:

- Independent of near-term budgetary decisions (e.g., base force and other R&D and acquisition initiatives that will have an evolutionary impact on our counterproliferation warfighting capabilities).
- Independent of the debate on Service roles and missions.
- Not too "scenario specific."
- Directed to identified political or operational issues.

The next MRC will probably not look much like Desert Shield/Storm since we were not the only ones who learned from Iraq's mistakes and successes. Campaign designs and system architectures are needed that are more than just ad hoc lists of system solutions to elements of a specific scenario problem. Candidate solutions to individual problem elements need to be assembled into an integrated overall system with supporting analyses to justify specific decisions with clear traceable documentation showing the linkage between goals, strategies, constraints, and solutions.

A particular challenge facing S&SS is how to support the establishment of rational and supportable priorities. There is no shortage of candidate initiatives that *could* be of value in *some* future circumstance. Absent some national consensus on future threat scenarios and desired military capabilities and priorities, however, measuring the potential value (and, hence, the rationale for near-term R&D spending) of these ideas is a severe challenge. The United States needs a better view of:

- Where the country stands today in terms of meeting or preparing to meet emerging military requirements.
- Threat scenario specifics and priorities so that planners can understand the overall impact of candidate ideas in terms of meeting projected mission needs.
- Alternative systems architectures to assess R&D and acquisition balance (e.g., investment time phasing).
- Technical, schedule, and cost risks and appropriate hedges.

The first point suggests starting with a more evolutionary viewpoint. Does "the counterproliferation problem" introduce revolutionary

new issues that must be addressed with revolutionary new technologies and systems applications? In fact, it does appear that the proliferation of WMD—and nuclear weapons, in particular—may have a profound impact on the U.S. ability to project power in the future and on U.S. susceptibility to political and military coercion. The military dimension of the proposed solutions cannot ignore these fundamental issues: (1) under what circumstances will the country want to have military options against a WMD proliferant, (2) how will the United States project power, and (3) how will the United States defend itself from coercion and direct (maybe unconventional) attack with WMD?

The military answers to these questions must be developed in an evolutionary context. The force posture for the foreseeable future, except for details, would appear to be pretty well defined. What counterproliferation-related new missions are emerging that these forces and operational concepts cannot meet effectively?

- Projected U.S. intelligence and surveillance systems are inadequate. If the country needs to hold at risk every WMD weapon and delivery system, or even just the nuclear systems, it will likely fail. Possible exceptions might include the early stages of proliferation in which the enemy has only a handful of weapons *and* the United States gets lucky.

- Strike systems have responsiveness limitations. Under the best of circumstances, it will take days to weeks to months (as in Desert Shield) to project decisive force and support systems to the theater. Under the worst of circumstances, the U.S. forces will have to fight their way on shore. This may imply that the United States will be faced with a military *fait accompli*, putting it in the unenviable position of having to retake captured, heavily defended territory to establish bases for counterproliferation campaigns—not an easy or cheap proposition.

- While the country has taken some passive and active defense measures that allow it to operate (albeit at reduced effectiveness) against WMD threats (particularly chemical), the United States does not have the doctrine, forces, or logistics systems that are suitable for the full range of possible WMD threat scenarios.

- The military has firepower and lethality shortfalls against certain types of time-critical targets, particularly dispersed and hardened facilities such as weapons storage and command bunkers/underground facilities and moving targets such as missile TELs.

Evolutionary enhancements can address these deficiencies to some extent. An obvious example is bomber systems. B-2s could act as a surveillance platform and battle management system for B-52s and B-1Bs as well as other weapons carriers. However, the United States may want to buy an even more specialized or limited-purpose conventionally armed ICBM or SLBM. Issues such as these are dependent on policy decisions that have yet to be addressed, and that probably cannot be adequately addressed until policymakers have a better appreciation of potential counterproliferation capabilities.

In terms of the second of the needs cited above, how "scenario specific" do planners need to be? Ideally, they should be very specific, but in generic terms. For example, there appear to be some clear generic scenario "breakpoints":

- Preemption
- Strategic (versus tactical) emphasis
- Nuclear use by the United States.

Preemption is mentioned first because a lot of the intelligence, surveillance, and long-range strike capability discussed so far in the "strategic futures" context really is in support of preemptive options. Under what circumstances can planners envision that the United States will decide to start the war? In even more stark terms, can planners imagine surprise "preventive" strikes such as the Israelis conducted against the Iraqi nuclear reactor? What about nuclear first (preemptive) use (if it is required to kill dispersed and hardened targets)?

These questions are of more than academic interest if S&SS expects to acquire new long-range surveillance and attack systems. For example, suppose that the United States knows (through HUMINT, for example) that a hostile power is about to assemble several nuclear weapons using nuclear materials stored in an underground facility

(for which targeters have the construction details). Suppose further that it is known that once these weapons have been assembled they will be dispersed and the United States will likely lose track of them. Suppose that once this is achieved, the hostile country will make demands that would seriously imperil U.S. national security or vital economic interests in some part of the world. Is this generic scenario plausible enough to be useful in rationalizing near-term R&D investments to provide preemptive options beyond what would otherwise be available? Examples are (1) surgical nuclear weapons (e.g., subkiloton nuclear EPWs) delivered by ballistic missiles or stealthy long-range aircraft, (2) nonnuclear weapons with enhanced lethality against buried targets, (3) improved (intrusive) surveillance (e.g., via tagging) so that the United States will not lose the nuclear weapons even if they are dispersed, and (4) "leak-proof" theater missile and air defenses as a hedge against less than total success in preemptive strikes.

Considering the range of possible force projection scenarios (we may be getting a glimpse of this in the former Yugoslavia with the debate on the utility of U.S. air power), planners must address the issues of responsiveness and exposure, in addition to preemption. What can we hope to achieve from a distance with long-range delivery systems such as bombers, ICBMs, and SLBMs? Can a campaign of strategic bombardment be effective without other power projection assets (such as ground forces) in place (1) to buy time to deploy them (the B-2 story), (2) to fight our way into the theater while minimizing our exposure to enemy WMD (no forces deployed as "trip wires") by systematically drawing the WMD systems down first, or (3) simply to add punitive military strikes to increase the effectiveness of other coercive measures (such as blockades and embargoes). Unless there is some acceptance of these warfighting concepts, it is unlikely that the kinds of "strategic" systems suggested in this study will be seen as anything other than curiosities. No "silver bullets" have yet been identified that will turn a future conflict that is "under the nuclear gun" into the preproliferation (Desert Shield/Storm) case. Until policymakers and warfighters step up to these issues, strategic ACTDs will not be taken seriously.

Finally, the issues surrounding U.S. use of nuclear weapons (either preemptively or in response to enemy use) in other than the traditional strategic deterrence context are not primarily technical, but

rather moral, political, and practical. Until such issues are vetted as a whole (through processes such as the STRAT-Y planning exercise described above), the prospect of nuclear EPWs, for example, no matter how appealing technically, will not be considered seriously.

Given convergence on threat scenarios and "acceptable" military options, some architectural context is necessary to ensure completeness and balance in the R&D initiatives. At a rather simple level, for example, sloppy surveillance can be compensated for with massive firepower and, conversely, limited firepower can be effective with superb surveillance.

Can the technologists deliver on the capabilities they envision? If so, on what schedule? Coming back to the evolutionary theme we started with, it would seem that prudence dictates that defense planners exploit opportunities incrementally, at least until some breakthrough actually occurs. The United States probably should not invest too much yet in systems that will only be effective with the advent of multispectral, wide-area, high-resolution (ATC, ATR, and real-time sensor-to-shooter data transfer), multisource data fusion. The United States should be in a position to exploit these technologies and to help influence R&D goals and priorities, but it cannot yet count on them.

FUTURE DIRECTIONS

Continuing study is required to assist OSD in the development of counterproliferation R&D initiatives related to time-urgent projection of military power at long ranges and likely strategic and space systems operations that could support evolving U.S. counterproliferation policy and strategy.

The follow-on study approach, in design and implementation, must recognize the imperative of ensuring effective integration with other comparable counterproliferation activities, in particular those directed to the development of an integrated military operations-intelligence investment strategy.

A range of innovative and potentially useful counterproliferation systems and operations concepts—often coupled to associated "enabling" R&D initiatives—has begun to emerge in the context of

"top-down" counterproliferation policy exercises and other forums examining the counterproliferation problem. At the same time, there is a growing recognition that the counterproliferation campaign and military and intelligence operations performance levels—in terms of both effectiveness and timeliness—likely to be sought by the U.S. National Command Authority (NCA) (*and* key allies in potential future regional nuclear crises) pose new and daunting challenges to military and intelligence operations.

It is especially recognized that close coordination, at an unprecedented level of detail and timeliness, between operators and the intelligence community will be a key factor in the kind of comprehensive "systems" or "combined arms campaign" approach to the counterproliferation problem that is clearly going to be required to meet the high-counterproliferation performance goals that are now emerging. This fact spurs the need to develop an integrated military and intelligence investment strategy.

Mechanisms are needed to effectively integrate the key elements and associated practitioners relating to the overall counterproliferation problem—the policy community, the military operators, the intelligence community, and the technical community—to crystallize and launch R&D initiatives that will be politically sustainable in the anticipated continuing tight defense/intelligence budget environment. The "Day After . . ." policy-based exercise format employed in the later stages of the initial Strategic Futures project will likely continue to prove a useful mechanism to facilitate the generation and exchange of ideas on such matters.

This continuing work should build on other OSD- and Air Force-supported work that is examining the counterproliferation problem from a "top-down" perspective. In addition to building directly on the counterproliferation work in the Strategic Futures project, follow-on work can take advantage of ongoing Air Force–supported work on the military-intelligence investment strategy problem (and the kinds of counterproliferation missions and capabilities that NCA decisionmakers might want to see achieved) at low threat levels. Follow-on work will adopt a long-term perspective on this overall subject, looking at R&D initiatives relating to military and intelligence responses to the more stressing threats, both in terms of size and character, that we could well face early in the 21st century.

A critical element in this undertaking will be an exploration of the potential nuclear strategies of the adversaries (and friends) who are players or have leverage in 21st century regional nuclear crises and the implications therein for missions/tasks/capabilities that the U.S. NCA would like to have available. Future study efforts should seek to identify in particular just how a well-armed nuclear adversary might seek to use its nuclear weapons strategically to gain decisive advantage and meet war aims in regional contingencies—and the capabilities that would be required to deter or otherwise thwart or frustrate such efforts.

In sum, future studies need to examine the kinds of counterproliferation campaigns that the United States and its allies might want to carry out in regional crises early in the 21st century, identifying those missing or weak elements that undermine the level of campaign effectiveness desired. A detailed examination of these key missing elements—and associated concepts of operations and new weapons systems that could remedy these shortfalls—should produce a set of candidate counterproliferation R&D initiatives for possible championing by the defense and intelligence communities in the demanding fiscal environment anticipated in future budget cycles.

Appendix

DEALERTING, MONITORING, AND WARNING—STRATEGIC NUCLEAR FORCE POSTURE ISSUES AND APPROACHES

OVERVIEW

As a consequence of the agreement signed by Presidents Bush and Yeltsin, the number of deployed strategic nuclear weapons will be substantially reduced. The process of reducing U.S. and former Soviet inventories from Cold War levels to several thousand strategic nuclear weapons on each side will take a decade or so both because of the costs involved and limitations in the capacity of facilities to store weapons and to dismantle them. Political problems beyond those of resource allocations might lengthen this period.

Nevertheless, there are sound reasons why it would be desirable to disengage the nuclear forces scheduled to be phased out more quickly. Disengagement will expedite the arms reduction process in the former Soviet Union. With fewer weapons on alert, the risk of accidental or unauthorized use of nuclear weapons under the unusually dynamic conditions there will be lessened. If the weapons to be disengaged included MIRVed ICBMs in silos, which constitute vulnerable, lucrative targets for Cold War–type preemptive strikes, then (assuming reliable second-strike forces are maintained) crisis stability by the traditional Cold War definition could be enhanced. Crisis stability and other traditional strategic stability metrics could be further enhanced if reengagement of disengaged forces is observable, facilitating appropriate measured responses. Thus, disengagement options that are verifiable by traditional measures are strongly preferred. Finally, disengagement provides an opportunity to posture those nuclear weapons as safely and securely as possible.

Disengaging nuclear weapons entails dealerting nuclear forces and, in the context of this Appendix, the terms "disengaging" and "dealerting" will be used interchangeably.

While the United States and Russia dealert strategic nuclear forces, it is important to maintain certain constraints, including U.S. retention of a consensus level of adequate strategic nuclear forces—and the capability to generate additional forces—so that national security is resilient to threats that may arise. Of particular significance in this regard is the nuclear deterrent force that the United States maintains on alert. For the foreseeable future, the United States must be able to respond to the possibility of a resurgent, aggressive Russia through the ability to reconstitute forces. This implies that the United States must maintain in a readily reconstitutable fashion those core technical competencies necessary to build additional nuclear deterrent forces. Finally, the strategic nuclear forces and capabilities that the United States maintains must be affordable in the face of competing national priorities.

The United States faces a number of challenges as strategic nuclear forces are reduced. At present, it is accepted that the U.S. nuclear forces substantially exceed those required for deterring present-day Russia. This excess capability serves as a hedge against unforeseen failures in one or more legs of the U.S. strategic triad. As the United States reduces its strategic weapons under START I and START II, U.S. forces will decrease to the point where they more closely match stated force level requirements (which may independently decrease because of the evolutionary reductions in the Russian target base). This minimum force level for a suitably hedged deterrent force remains to be determined, but many strategists accept the START II goals as above the new U.S.-Russian consensus (from which, presumably, to address multilateral nuclear reductions).

A substantial disengagement of nuclear forces will affect the post–Cold War environment in several ways. First of all, disengagement would precipitate a quicker drop in force levels than would be the case in the absence of disengagement. It takes longer to dismantle forces than to dealert them. Second, it is possible that the disengagement process would foster a more cooperative relationship between the United States and Russia, which in turn could lessen the possibility of untoward Russian behavior in the future. Finally, if

superpower relations sour before weapons have been dismantled, Russian reengagement of disengaged forces would provide both visible evidence of an impending crisis and a clear signal to which the United States can respond by realerting its disengaged forces. If we take prudent actions in response to warning, we would be no worse off than we would be if forces were never disengaged.

In this study, we have identified several disengagement ideas worthy of Department of Defense/Department of Energy (DoE) consideration. We need consensus on a clear set of goals and strategies to reach them. What are the appropriate disarmament, disengagement, rearmament, and reengagement measures of effectiveness for the current environment? We must look well beyond the numbers game of SALT and START. Based on experience, a consensus on such metrics will emerge only from the goal-seeking process. That process—for the post–Cold War strategic environment—is only now beginning (though it does seem to be to picking up steam).

We were not able to develop the ideas presented here in any detail, and more work on this subject by the Services and the intelligence and aerospace communities is clearly required. The work to date should help focus those further efforts.

BACKGROUND

RAND and the three DoE nuclear weapons laboratories (Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory) were asked by the Office of Strategic Competitiveness within the Office of the Under Secretary of Defense (Policy) to address the tasks shown in Table A.1 in support of the Defense Policy Board Task Force on the Future of American Nuclear Weapons. The hope was that viable options could be defined to serve as a basis for future discussions of the concept of disengagement of forces.

The first task was to use the laboratories' technical expertise to conceive of methods to dealert the strategic nuclear forces of Russia and the United States. All concepts were to be assessed according to various criteria to be discussed below, and the best concepts were to be defined in more detail. We were later told to focus on the

Table A.1

Study Guidance

- Develop concepts to disengage strategic nuclear forces, focusing on Russian forces.
- Focus on weapons systems scheduled to be dismantled or destroyed by 2003 under the Bush-Yeltsin agreement.
- Seek ways to increase stability by disengaging vulnerable Russian weapon systems preferentially.
- Evaluate monitoring requirements and capabilities.
- Assess the dynamics of reengagement to examine stability.

weapons systems that are to be dismantled or destroyed under the Bush-Yeltsin agreement of June 1992.

After assessing the concepts proposed in this stage, the DoD instructed us to concentrate on silo-based ICBMs, as these systems are vulnerable and of particular concern for stability.

Additional tasks included evaluating the monitoring requirements for the disengagement options and monitoring available capabilities. We were also asked to evaluate the dynamics of reengagement to avoid instabilities.

CRITERIA TO DETERMINE SUITABILITY

Each option that we conceived for disengaging strategic forces went through a screening process. The criteria included:

1. Monitorability of the force posture. How well can one verify that the weapon system has been dealerted and how confident can one be that the process of realerting forces can be observed?
2. Regeneration time delays imposed. How long does it take to regenerate forces? What is the regeneration time compared to the time scale associated with observing a change in the force posture?
3. Safety and security of Russian weapons. Is there a positive, a negative, or no impact on weapon safety and security as a consequence of a disengagement concept?

4. Stability, including the process of regeneration. What is the overall impact on first-strike stability? This is the reason for the study emphasis on disengagement of vulnerable weapon systems which, if on alert, may be in a "use or lose" situation.

5. Survivability of the disengaged posture. In general, dealerting can result in lessened first-strike survivability for the disengaged systems. The aim is to maintain sufficient survivable alert forces so that there is minimal first-strike incentive. As noted above, the forces on alert should not be of a type that relies on prompt retaliation for survivability.

6. Affordability. The disengagement option must be affordable, both in terms of cost and time to implement.

7. Transparency of posture changes. Are graded force responses possible and are they observable? This issue is closely related to monitorability.

MONITORING OF FORCE POSTURE

Monitorability is so important that we built a suite of models to determine confidence in monitoring a change in force posture as a function of the reengagement rate, the monitoring rate, and the exposure of the systems to observation. Figures A.1 and A.2 show parametric results from one of the models.

The results depend on two important factors. The first is the monitoring concept, such as national technical means (NTM) to randomly sample targets, challenge on-site inspection (OSI) to periodically monitor the status of a target, and on-site (electronic) monitoring to report back any irregularity that must be further checked. The second important factor relates to target characteristics. Examples include the number of targets to be monitored, and whether realerting results in a permanent observable change or one detectable only during the realerting process?

Figure A.1 shows the expected alert level when the realerting process is detected by our monitoring system. Figure A.2 shows the probability that realerting is detected before thresholds of 10, 50, or 90 percent are reached.

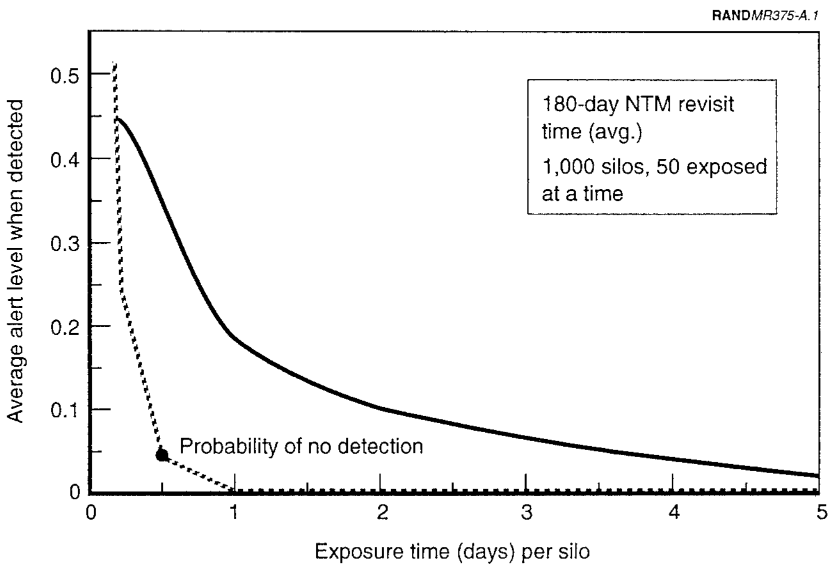

Figure A.1—Average Alert Level When Detected

Note that the abscissa is the exposure time per silo. This model assumes that the realerting is detected only if a silo is observed during this exposure period. A real-world example might be a case in which we were limited to NTM to monitor the status of the silo-based force and missiles were defueled to take them off alert. Realerting them requires observable activity at the silo (e.g., the presence of refueling vehicles). However, once the operation is completed, it is no longer detectable that the missile has reverted to alert status. The cases shown here assume a typical NTM revisit time of 180 days.

DISENGAGING SLBM SYSTEMS

The methods for disengagement of SLBM forces considered by the study team fall into five categories:

1. Detargeting: This is not likely to be verifiable, but it may have other positive attributes and little or no downside risk.

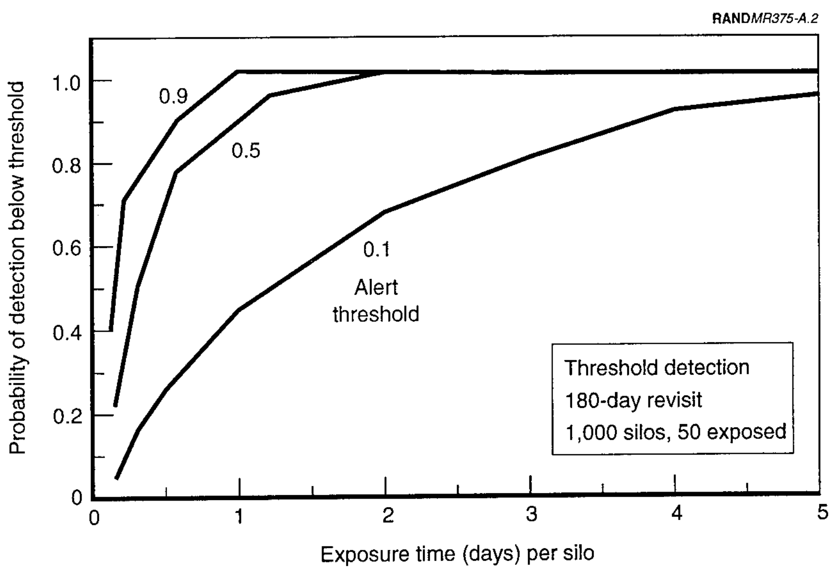

Figure A.2—Probability of Detection Below Threshold

2. Constrain areas of operation: The idea is to disengage SLBMs by placing SSBNs on patrol in areas where their missiles are out of range of their targets. In principle, this can be accomplished either by adjusting the patrol patterns (which does not address the troublesome issue of Russian "pierside alerts") to reduce missile range or by rebasing SSBNs at main operating bases out of range to the target (and thereby also solving the problem of pierside launch potential).

3. Off-load key components: The components could be missiles, warheads, or launch equipment (codes, keys, etc.). The components could be stored shoreside or on tenders. This concept introduces some important bottlenecks in realerting SSBNs.

4. Separate warheads and missiles on-board: On-board separation of a key component entails off-loading missiles from SSBNs rather than de-MIRVing missiles. The spare launch tubes would be used to store the warheads, which were off-loaded from the remaining missiles. This might address the problem of disengaging the at-sea forces without compromising their survivability.

5. Lock key components: Two particular ideas are to lock (or weld shut) the hatches or to install a destructive obstacle in the launch tube to prevent launch. An example of the second idea is presented later in this Appendix.

MONITORABILITY OF SLBM DISENGAGEMENT OPTIONS

Table A.2 presents the key issues pertaining to the monitorability of the SLBM disengagement concepts considered by the study team.

The right columns show judgments on monitorability using NTM and challenge or continuous OSI. Detargeting is not monitorable by any means we could discover. This does not mean, however, that we should ignore this disengagement candidate; we should not, however, indicate in any way that we are sensitive to detargeting assumptions or details we cannot observe.

Table A.2

Monitorability of SLBM Engagement Options

Candidate Measure (P=pierside; S=at sea)	Observable	Monitoring Challenge		
		NTM	Challenge OSI	Continuous
Detarget	No	No	No	No
Constrain ops area (S)	Cooperative	Yes, coop	Yes	No
Store warhead ashore (P,S)	Yes	Yes	Yes	Storage facilities
Store missiles ashore (P,S)	Yes	Yes	Yes	Storage facilities
Store essential equipment ashore (P,S)	Probably no	No	Yes, but inadequate	No
Store warhead on board (P,S)	Cooperative	Maybe coop	Yes	No
Lock hatches (P,S)	Cooperative	Yes, coop	Yes	Pierside
Destructive obstacles in tubes (P,S)	No	No	Yes, but inadequate	Pierside

For constraining operations (ops) area, on-board storage of warheads, and locked hatches: The observability of the disengagement option depends on cooperation. In all these cases, NTM and challenge OSI would be the basis for verification. The NTM entries "Coop" indicate that with the cooperation of both U.S. and Russian authorities, NTM can be used in monitoring these disengagement options. In the specific case of constraining operations areas to out-of-range areas, the submerged boats would agree to broadcast "I am here" signals so that NTM could verify they were out of range. Similarly, monitorable electronics would contribute to monitoring warheads stored on board and locked hatches by broadcasting "I am well" signals whenever the submarine surfaces. The issue is survivability degradation potential. In effect, we would be periodically giving the Russians ground truth on where our submarines are (or were, in the more likely case of broadcast delays from expendable buoys). This information might help the Russians develop or evaluate the effectiveness of antisubmarine warfare (ASW) technologies and systems concepts.

For ashore storage of missiles or warheads: Monitoring is straightforward in these cases. NTM, challenge OSI, and continuous OSI all seem to be feasible. The issues are the cost of handling and storage, safety and security, and the significant decline in system survivability due to increased warning time sensitivity.

For ashore storage of essential equipment: High-confidence monitoring is problematic. Even challenge OSI may not be feasible because of the potentially short time it might take to change the status of the system. Also, spare equipment may be stored clandestinely aboard the SSBN.

We were unable to identify any bilateral ideas for disengaging the SSBNs that we feel are both in our best interests and negotiable with the Russians except, perhaps, detargeting, which is not monitorable. From our perspective, Russian pierside alert is most troublesome. Removing missiles from boats in port and sealing hatches are the closest we could come to solutions to that problem, but they may be unacceptable to the Russians, particularly as they build down their ICBM forces to near zero. The United States should be reluctant to take any measures that might in any way compromise the survivability of our SSBNs at sea.

Some disengagement options entail the removal of critical equipment from the SSBN. These options tend not to be verifiable in the absence of intrusive (and expensive) on-site monitoring. There may be merit to applying these options to pierside SSBNs to provide protection against accidental or unauthorized launch.

Concepts that entail off-loading of warheads or missiles are monitorable but are expensive because of the need to construct additional storage facilities. They may be feasible for pierside SSBNs, but would hurt survivability of at-sea SSBNs.

The idea of having SSBNs patrol out of range does not appear to be workable for the Russians unless they rebase their Northern Fleet. Their SLBMs have sufficient range to launch from the port area from their northern bases. Rebasing would be expensive.

The feasibility of the on-board off-loading of warheads depends on engineering details. The concept is liable to be expensive and may compromise SSBN survivability if shoreside equipment is needed to remount warheads on missiles.

The feasibility of obstructions in the launch tube also depends on engineering details. It might be a workable option at least for shoreside SSBNs. Monitorability depends on reliable electronic sensors. In any case, the time required to regenerate forces may not be long.

DISENGAGING AIR-CARRIED WEAPONS

Disengagement options for the strategic bombers differ from those for the ballistic missile forces in a number of ways. Russian strategic bombers are not assessed as being at a threateningly high level of alert, nor is the force large enough (aircraft, weapons, or trained crews) to pose a threat comparable to that of the ICBM or SLBM forces. U.S. strategic bombers have been taken off alert as part of President Bush's September 1991 Presidential Nuclear Initiative (PNI). Bombers, because they are manned (i.e., recallable) and are relatively slow flyers, are not as immediate a threat as ICBMs or SLBMs. For the United States at least, strategic/heavy bombers have a significant conventional weapons role, whereas ballistic missiles (currently) have only a nuclear warfighting role.

Primarily for these reasons, the disengagement options for aircraft-delivered weapons tend to deal with procedures or the nuclear weapons themselves, not the launchers (aircraft). In fact, it could be argued that the aircraft (but not the nuclear weapons) should be returned to alert status once the weapons have been dealerted or the aircraft have been denuclearized to enhance survivability.

DISENGAGING ICBMS

Numerous disengagement options were considered for silo-based ICBMs, and many of these also apply to Russian mobile systems. To the extent that options apply equally to fixed and mobile ICBMs, they are discussed here without distinction. The options tend to fall into four categories:

1. Disengage command and control systems: These options would be reversible and easily circumvented, but there may be some benefits ("good will" and less chance of accidental launches, for example).
2. Prevent any missile launch: Defueling is reversible, puncturing oxidizer tanks or notching solid boosters less so.
3. Prevent successful missile launch: A variety of these options tended to be the focus of the study team effort. Restraint or disablement may be less costly than the partial dismantlement options mentioned below.
4. Separate warheads and missiles: These options range from detaching the warheads from the missile but leaving them in place in the silo to partial dismantlement with some equipment removed from the silo. Long-term warhead storage is an issue.

With the exception of the options dealing with demating the front-ends and defueling the liquid boosters, the options presented here apply to mobile ICBMs as well as silo-based missiles. In addition, mobile systems possess design characteristics that permit other possibilities for rapid disengagement. For example, physical removal of essential support vehicle(s) might result in dealerting the garrison. The mobile missiles, canisters, and launchers (TELs) themselves might also provide unique opportunities for disengagement. All Russian mobile ICBM systems are three-stage, solid-rocket missiles,

cold launched from sealed canisters using a launch-assist device. A critical component could be removed or a scheme for obstruction of launch capability could be devised. Because access to a critical subsystem within the canister or on the launcher would be much easier on a mobile system than on a silo-based system, the disengagement options may be cheap and easy to implement. However, it follows that disengagement might also be quickly or surreptitiously reversed.

MONITORABILITY OF ICBM DISENGAGEMENT OPTIONS

Detargeting is not monitorable by any means we could discover. This does not mean, however, that we should ignore this disengagement candidate; we should not, however, indicate in any way that we are sensitive to detargeting assumptions or details we cannot observe.

On-site sensors could contribute to monitoring of all of the ICBM disengagement options. They could sense movements of heavy vehicles or equipment, or entry of personnel into prohibited areas, and report this information.

Three candidate measures appear to be more monitorable in that they lend themselves to observation by NTM and either challenge or continuous OSI. The concepts are (a) defueling the missile (most applicable to liquid-fueled boosters); (b) piling dirt, boulders, or other obstacles on top of silos; and (c) remote storage of the warheads. All these options entail some expense (probably the most for the third), but the first two options likely could be implemented reasonably quickly.

Two other potentially workable options are storage of warheads in empty silos and use of a destructive obstacle in the missile silo or canister. Both rely on cooperation for an observable signature and both are problematic for use of NTM. The obstacle option relies heavily on on-site electronic sensors for monitoring, but could be implemented quickly. By comparison, the empty-silo option cannot be pursued until at least some of the force has been dismantled.

The removal of a critical missile component, as discussed in the case of SLBMs, suffers from serious concerns about verification of disengagement and the ease and rapidity of reengagement.

Puncture of the fuel tank—or any other option that entails physical damage to the missile system—is technically feasible but essentially irreversible. It may be difficult to convince the Russians that it is in their best interests to pursue such an option.

Table A.3 describes the likelihood of detecting realerting prior to a selected realertment threshold.

The last column of Table A.3 shows the required monitoring rate (given the assumed realerting potential) to ensure that there is a 90 percent chance that we would detect the realerting before the Russians were able to get half their force realerted. By comparing these requirements with the assumed monitoring rates for NTM and OSI, we can note where these illustrative calculations are consistent with our judgments about the monitorability of the selected disengagement concepts.

Table A.4 summarizes the evaluation of the nine ICBM dealerting candidate measures against the seven criteria provided by DoD/ Policy as cited above.

Table A.3

ICBM Monitoring Requirements

Candidate Measure (S=in silo, M=mobile)	Assumed Realerting Rate (%/time)	Assumed Monitoring Rates	Monitoring Rate for 90% Confidence of 50% Threshold
Detarget	100/hour	1/month (OSI)	5–20/hour (OSI)
Defuel missile (S)	5/day	5/day (NTM)	5/day (NTM & OSI)
Puncture fuel (S,M)	10/year	5/day (NTM)	3/day (NTM & OSI)
Remove critical msl component (S,M)	10/hour	1/month (OSI)	0.5–2/hour (OSI)
Dirt/boulders (S)	10/day	5/day (NTM)	0.5–2/day (NTM)
Structures (S)	10/day	5/day (NTM)	0.5–2/day (NTM)
Obstacles in silo or canister (S,M)	10/day	1/month (OSI) to 5/day (NTM)	0.5–2/day (OSI) to 7/day (NTM)
Store warheads in silo (S)	10/day	1/month (OSI) to 5/day (NTM)	0.5–2/day (OSI) to 7/day (NTM)
Store warheads remotely (S,M)	10/day	Cont (OSI)	0.5–2/day (OSI)

Table A.4

ICBM Dealerting and Monitoring—Summary Evaluation

Candidate Measure (S=in silo, M=mobile)	Monitor	Realert Time	Safety & Security	Stability	Survive	Cost	Transparency
Detarget	None	Hours	Central Control	No effect	No PRL in B-F-T-B	No cost	None
Defuel missile (S)	NTM & OSI	Weeks					Yes with OSI
Puncture fuel (S,M)	NTM & OSI	Years					Yes with OSI
Remove critical msl component (S,M)	OSI?	Days					Yes with OSI
Dirt/boulders (S)	NTM	Days–weeks	Secure RV storage, no accidental launches	Crisis transition issues?	As above plus post-attack generation issues	Modest (TBD)	Yes
Structures (S)	NTM	Days–weeks					Yes
Obstacles in silo or canister (S,M)	NTM & OSI	Days–weeks					YES with OSI
Store warheads in silo (S)	NTM & OSI	Days–weeks					Yes with OSI
Store warheads remotely (S,M)	OSI & NTM	Days–weeks	Secure storage			High? (New bunkers & transporters)	Yes with OSI

NOTE: No PRL in B-F-T-B = No prompt retaliatory launch in a bolt-from-the-blue [attack].

Safety and security: Detargeting might increase central political control and so would be beneficial (although nonmonitorable). Most of the other candidate measures improve security by greatly reducing the likelihood of an accidental launch, and they preserve the security of the nuclear weapons because they would be kept in their currently well-guarded silos (unlike the United States, Russia stations well-armed troops at each silo 24 hours a day). Storage of weapons may be a security issue.

Stability: Detargeting, because it is difficult to monitor and would not be relied on, would have no effect on crisis stability (each side would assume the other had their forces targeted). The other measures have a curious mix of stability qualities. The good news is that in a crisis, it would take time to realert the forces—time that might be used to defuse the crisis. The bad news is that the realerting measures could be considered provocative and the forces being realerted would be vulnerable to a first strike. To some extent, these stability issues will be mitigated by de-MIRVing, but the vulnerable nature of the forces will remain.

Survivability: Related to stability is the issue of survivability. For most of the dealerting concepts survivability is reduced, at least in the sense that a prompt retaliatory launch (PRL) would not be feasible day-to-day. The issue is the degree to which this temporary PRL restraint might increase the pressure on either side to preempt in a crisis, thus increasing crisis instability.

Cost: We were unable to generate cost estimates to implement these candidate measures or to monitor them. The qualitative distinctions shown here are probably representative in a relative sense.

Transparency: Except for detargeting, most measures are relatively transparent, particularly in a cooperative OSI regime.

The study team concluded that the following three concepts warranted study in more detail:

1. Defuel liquid boosters: Although this concept is not applicable to all ICBMs, it addresses disengagement of Russian SS-18s, which are the missiles of greatest concern to the United States. The concept has excellent monitorability features.

2. Cover silo doors with dirt, boulders, or structures: This concept also has excellent monitorability features and could be applied to all silo-based ICBMs.
3. Install destructive obstacles inside the missile canisters or silos: Compared with the first two concepts, this option relies more heavily on (electronic) on-site monitoring to ensure disengagement. However, the concept may be applicable to mobile ICBMs and SLBMs while SSBNs are in port.

All three ideas need additional work and engineering details to prove feasibility. Although we believe each is affordable, the cost of each of these disengagement options needs to be estimated carefully.

DEFUELING LIQUID-FUELED MISSILES

Defueling liquid-fueled missiles appears to be an obvious option for a significant fraction of the Russian ICBM force. Most of the silo-based Russian ICBM systems employ liquid-fueled boosters. Over 600 missiles and nearly 5000 warheads could be disengaged. (There are no liquid-fueled ICBMs in the U.S. arsenal and the Russian SS-13 silo-based ICBMs, SS-24 silo-based and rail mobile ICBMs, and the road mobile SS-25 ICBMs are solid-fueled.)

To assess the viability of defueling liquid-fueled boosters, the SS-18 ICBM system was examined in detail using intelligence community assessments and START technical inspection reports. The fueling of an SS-18 booster requires numerous ground-support vehicles and a significant amount of time to complete.

BOULDERS OR CONCRETE BLOCKS PLACED TO FALL INTO THE SILO WHEN THE DOOR IS OPENED

A second concept for disengaging silo-based ICBMs entails the placement of dirt and boulders or concrete blocks on top of the silo door to impede the ability to launch. Russian silo doors are built to break through ejecta piles several meters thick. Our concept for covering the doors relies on boulders or concrete blocks placed to fall into the silo if the door is opened. The boulders must be big enough to not go down around the annulus, and they should critically damage the canister when they fall onto it. It is estimated that missile

launch could be delayed by five to eight hours until the overburden can be cleared away by heavy machinery.

Two factors make reengagement of missiles observable. First, like the defueling concept, the need for heavy equipment near the silo for an extended period of time provides a convenient opportunity for detection by NTM (observation of silos, heavy equipment motor pool areas, or both). Second, the removal of dirt provides a visible permanent signature that the silo-based missile has been reengaged.

Concerns about use of overburden to prevent launch stem from the major benefit of the concept—the difficulty in accessing the missile. These doors are the only access into the Russian silos, and it is possible that the Russian safety requirements are such that we must not enforce delays in opening them. The presence of the dirt and boulders may make silo and missile maintenance considerably more expensive.

PLACING AN OBSTACLE IN THE CANISTER OR SILO ("DENVER BOOT")

The concept of including an obstacle in the missile canister or silo to prevent missile launch merits a closer look. This idea, which has some analogies with the "Denver boot" used to prevent movement of automobiles, has a number of possible realizations. One possibility is a heavy metal ring that is attached to the inside of the missile canister with three or four teeth pointed inward. Should the missile be launched, the teeth would cut slices down the sides of the booster. As an alternative, the Denver boot could be a doughnut-shaped obstacle that would damage the raceway on the side of the booster that contains cables for missile control.

SUMMARY ASSESSMENT

Each of these concepts for disengaging Russian ICBMs needs additional study; however, we believe that schemes for monitoring disengagement are workable in each case. Their selection as potential concepts, in fact, was partly based on the supposition that these disengagement methods would be monitorable. NTM likely suffice for the refueling of liquid boosters or for using external obstacles to pre-

vent either silo door opening or missile launch. For the obstacle in the silo or canister case, NTM might suffice through observation of motor pools for specialized equipment.

In at least two of the cases, OSI inspection can be used to enhance confidence that weapon systems have not been realerted (OSI is not required for the boulders-on-the-silo-door case). The idea would be to use unattended (electronic) on-site monitoring equipment, which has been developed by the DoE laboratories and others. Monitors could detect and provide information about vehicle movements or about breaking seals. The silo door could be sealed electronically or seals could be used to monitor the status of a canister or an obstruction in a canister.

The use of NTM or unattended monitoring equipment could be augmented by challenge on-site inspections. These inspections could be an integral part of the missile front-end/warhead inspections that are part of the START regime. Alternatively, they could be separate inspections but follow the same protocols. Challenge inspections could determine the amount and location of refueling or loading equipment; they could check the status of aboveground obstacles to prevent launch; or they could check the integrity of destructive obstacles inside silos.